Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 144 SATURDAY, AUGUST 26, 1939 No. 3643

THE BASIS OF LEADERSHIP

NO more fundamental question is raised in Sir Arthur Salter's stimulating book "Security: can we retrieve it?" than that of the selection and training of leaders in our democratic systems. Many of the dangers to which we are exposed at the present time, he maintains, are the result of defective leadership and not of inherent defects in our democratic institutions. We cannot assume too readily with Prof. Whitehead that the problem is not that of producing great men but of creating great societies, for the great society will put up the men for the occasion.

The present testing time for democracy is forcing us to realize that the two problems are linked inseparably. The question of educating for democracy involves the problems of selection and training for the ever more arduous duties and responsibilities which the growing complexity of the modern State is forcing upon the administrator and statesman. If we have to consider education for citizenship in the sense that the efficient functioning of a democratic system depends upon an intelligent and educated electorate capable of taking independent and unprejudiced views, we have equally to consider it in the sense of providing training which will fit men and women for the many posts in local and central government which under a democracy demand wise judgment, respect for human personality, impartiality and a sense of justice and human values.

The future of democracy may well depend on whether it can put up leaders of the requisite calibre alike in municipal or national affairs, free from party prejudices and capable of taking long views and resolute action. We are being driven to consider again the Platonic view of education—whether, in fact, our system of education should not include some special provision and training for those destined to carry the responsibilities of leadership and administration. The question of a ruling class has once again to be faced fairly and dispassionately.

This is the central problem which Mr. J. M. Murry has raised in a stimulating little book recently published*, and he insists on the necessity of a moral basis for leadership. It is indeed to the separation of religion from the social tradition of Christianity and the acceptance of the complete secularization of society that he attributes a large measure of responsibility for the dangers and difficulties which confront us to-day. There is a striking parallel between the absorption of the Puritan in private religious observances and its consequences, and the absorption of scientific workers in their own special branch of knowledge and their neglect of, or indifference to, the social consequences of their work. Both alike impoverish and cramp man's capacities and experience. Mr. Murry makes a passionate attack on the departmentalization of life from the religious side, an attack which should assist as much in bringing science and religion and ethics into that harmony so essential for man to regain his control over events as do the increasing efforts of leading men of science themselves to raise their fellows to a sense of their social and moral responsibilities, of which Sir William Bragg's Pilgrim Trust Lecture before the United States National Academy of Sciences provides a recent admirable illustration.

Mr. Murry argues that, broadly speaking, there are two educational systems in Great

*The Price of Leadership. By John Middleton Murry. Pp. 190. (London: Student Christian Movement Press, 1939.) 5s. net.

Britain. The first includes the education of the elementary school, that of the secondary school and finally university education, mainly scientific or technical. The second system, which begins with the preparatory school, and is followed by the public school and then by the university, leads to positions which can only be adequately described as those of the ruling class. Roughly it is true that the ruling class in the main receives a type of education entirely different from that of the rest of the people, and whereas the first system is almost exclusively an intellectual system, in the second intellectual values are definitely subordinated to training in character.

Mr. Murry considers that however lop-sided the public school system of values may be, it is much more realistic and effective than the system of values which prevails through elementary and secondary education, and that the insistence on its codes and traditions as more important than mere intellectual distinction makes for a real social coherence. He is accordingly concerned that we should attempt to preserve its virtues and to incorporate the public schools into the State system in a way that would render them no longer the preserve of the rich. He would achieve this either by bodily incorporating them into the State educational system and by drafting off to them boys who showed proof of a generalized rather than a specialized intelligence, or by founding at least two dozen State public schools which should take over the boy as completely as he is taken over by the existing public schools but should set themselves much more determinedly to discover the boy's real aptitudes.

The fundamental premiss in Mr. Murry's argument is that we should recognize both the existence and necessity in a democracy of a ruling class, and concern ourselves with the education by which a ruling class is formed. The necessity for a class of men educated and trained for administration is widely recognized in industry to-day, where the future of large-scale industrial combines and of the public utility corporation may well depend upon its solution, and less widely in modern society generally. The idea is inherent in the many discussions which have taken place in the last twenty years regarding the place of the scientific or technical expert in administration, and in such reports as that of the Departmental Committee on the Qualifications, Recruitment, Training and Promotion of Local Government Officers.

None the less, even those who are most alive to the social implications of the industrial combine of the public utility company are frequently blind to what is involved in the provision of leadership, and the reception given to the report on recruitment of local government officers indicates how far we yet are from appreciation of what is involved even in training for local administration.

This position is doubly dangerous. It undermines the efficiency of democracy by making it more difficult to secure and operate the regional planning of services such as health, transport, water supply, etc., which are becoming more essential in the general interest and may be vital as defensive measures in war time. Moreover, it hinders the linking of social privilege and social responsibility which has been so marked a characteristic of the development of the democratic system in Great Britain, and is more than ever essential if respect for human personality is to be preserved in the face of totalitarianism.

Mr. Murry indeed writes scathingly of many who profess to be leaders of democracy, and he demands clear and fundamental thinking on the two-party system and democracy as a whole to-day. What he is concerned to find is a system of education which will provide, not merely technically competent leaders, but also leaders who will safeguard for us the great values we have inherited. It is this view of life as a whole, in which moral and ethical no less than social, scientific, technical and artistic elements are respected and blended that leads him to place his main emphasis on the recognition by Christianity of its social relations and implications.

Already in other countries a new ruling class is coming into being, and the need in Great Britain is immediate. The character of the State is determined by the conception of its social responsibilities held by the ruling class. It can select, and under totalitarian impulses it does select, the elements of man's lower nature for embodiment in the character and purpose of the whole social order. Under Christian impulses it can equally reconstruct the State to serve the highest ideals of which humanity is capable. The choice made by the ruling class is determined by the training given to the minds of its members in the schools.

Mr. Murry asserts that the acceptance in Great Britain of State action solely as a channel of personal advantage without any philosophical or religious conception of the State as representative of the higher selves of man to whom duties are primarily owed, has left the moral initiative in

Europe to the new totalitarian nations. The conception of the State as the instrument by which a democratic society is educated to the knowledge of its own nature and purpose is, however, a Christian conception, and Mr. Murry clinches his argument by contending that the religious basis of social life at which he aims can be realized in the schools, and was realized by Dr. Arnold and others. Moreover, when the new industrialists entered the ruling class, they found that individualistic morality was insufficient, and from their ranks came the leaders of a new movement towards a social religion able to meet Marxian materialists on their own ground.

For Mr. Murry democracy cannot exist without Christianity. Unless democracy is constantly revivified by the regeneration of its individual members by Christian education, it must degenerate into totalitarianism. Either the individual must learn to conquer his lower self and attain his true personality as a citizen of a Christian society, or the democratic State, abandoned to be the instrument of the lower selves of its members, will enforce upon him a uniformity which is destructive of his whole personality. "A modern industrial and democratic society by reason of its economic complexity, cannot suffer itself to become anarchical. If it is not permitted to develop creatively into a Christian society it must become a totalitarian tyranny." Like Sir Cyril Norwood in his suggestive address last year on the relevance of Christianity in the modern world at the conference for young public schoolmasters, he claims that national education should be frankly based on Christianity conceived broadly in terms of the spiritual values of truth, beauty, and goodness—values which are increased by being shared.

With very much in Mr. Murry's argument scientific workers will find themselves in real sympathy. They are profoundly concerned with all that makes for the maintenance of freedom of thought, of speech and of investigation and the preservation of spiritual values. Respect for human personality should be as cardinal a principle with them as loyalty to the truth and disinterested search for the facts. In their growing concern for the social consequences of their work they are conscious that, as Sir William Bragg pointed out, in his Pilgrim Trust Lecture, the spirit in which knowledge is sought and the manner in which it is used may be more important than knowledge itself. They themselves have to supply the natural knowledge for a solution of the problems of society, and help in its application. Their effectiveness depends equally, however, on their moral influence, on the devotion, wisdom and good will which they bring to their task. They may well be grateful to Mr. Murry for the clarity with which he displays the moral issues, for the force of his challenge to discard cant about democracy and to think out all that is involved in the training and selection of leaders for democracy not merely as we know it to-day, but as it might be in an ideal society. Nor should they forget that such fundamental thinking will point the way for them to make their own contribution to leadership and to secure the more effective utilization in the service of the community of the knowledge already available and increasingly being placed at its disposal.

STATE-CRAFT AND MEDICINE

The Building of a Nation's Health

By Sir George Newman. Pp. xiv + 479 + 8 plates. (London: Macmillan and Co., Ltd., 1939.) 21*s.* net.

SIR GEORGE NEWMAN, until recently Chief Medical Officer of the Ministry of Health and of the Board of Education, in a preface to his latest work, entitled "The Building of a Nation's Health", states that he intends it to be a "summary record of how statecraft and medical knowledge took council together at the opening of a new epoch of preventive medicine". From one point of view this admirably describes the task which the author has so excellently performed. The responsibility for building and maintaining health in Great Britain may be said to be shared between the medical profession, the State, and the individual citizen. The part of the last named, though it is of essential importance and though it may even be obscured by some activities of the other two agencies, is not dealt with in Sir George Newman's book. This is legitimate, for the responsibility of the individual for his own health, and therefore to some extent for the common health, is somewhat apart from that of those other agencies, and may well be approached from a different angle and separately described or

enforced. The responsibility of the State and of the medical profession cannot, however, be so dissevered; and, indeed, one of the main features of Sir George's book is the clearness with which it brings out, and the force with which it emphasizes the unity of the field of medicine, and the need for the intimate co-operation of various bodies of persons within the wider field of health. This leads one even to hope that the phrase "preventive medicine", however convenient when carefully used, may be abandoned wherever possible, and the phrase "the preventive aspects of medicine" used in its stead. For "preventive medicine" cannot be separated either from "curative medicine" on one hand or from "constructive medicine" on the other. It is false to regard the State as being concerned with prevention and the medical profession with cure, or one class of medical practitioner as dealing with the former and another class with the latter. These are merely aspects, and not very clearly defined ones at that, of something which is essentially a unit.

It is but little more than a century since the State began to realize its responsibility for the public health and actively to exercise its functions in relation thereto. During that century, and especially during the last thirty-five years or so, it has taken a constantly widening and more serious view of these responsibilities and functions. It was at first concerned, and is still perhaps primarily concerned, with environmental factors and the control of epidemic disease; but it is now enlarging its conception even of these so that the nutrition of the people and the opportunities for physical exercise and training are now regarded as its business. Further it has interested itself in the better education, regulation, and organization of the medical profession, and of ancillary health workers, so that their services may be more easily available for the public and more effective when used. It has brought medical advice and treatment within the means not only of the very poor but also of every worker, and has provided medical attention for other classes of the population and for certain abnormal conditions or diseases of more than ordinary communal importance. It is the whole of this field which Sir George Newman surveys in his book. No other person could have done it so appropriately, so comprehensively, or so well. It is not only that he has held positions in the public service which have afforded him unrivalled opportunities for knowing or observing almost every movement in this extensive sphere, but that he himself, in those positions, has been a motive, a controlling, or a directive force during twenty-five years or more of official life. Moreover the interested public has long recognized, through his series of annual reports as Chief Medical Officer to the two Government Departments most concerned with health matters in England and Wales and through his other writings, that he has a faculty of marshalling and setting out his material, and of attractive statement of facts and expression of ideas and opinions which add to the value of what he has to say and commend it to his readers. All these qualities are evident in his latest book, which, though it is to be hoped that it is not his last, may be regarded as his most important contribution to an understanding and appreciation of the national movement towards health with which he has been associated.

Very properly, and with evident deliberation, Sir George Newman places the medical profession in the forefront of the picture. He traces its governance and regulation through the Medical Acts and the General Medical Council, expounds recent movements and the new spirit in medical education, and discusses the status, duties, and privileges of medical officers and private practitioners in relation to communal requirements and public authorities. "Nothing is more remarkable," he says, "in the history of the public medical service in Britain, than the great and continuing contribution made by the medical practitioner." The delay by the State in making use of these contributions cannot fail to be noted. There is a lag between the acquirement of knowledge by research and the application of this knowledge in actual medical practice. There is a further lag between this application and the action of the State towards making it more easily and widely available. This is natural enough, and may even be advantageous, provided the lag is not too great, and that it is not due to professional negligence, obstruction, or claims to the sole occupancy of fields which are not wholly medical.

Next in importance to medical work and influence in the building of the nation's health has been that of voluntary societies and movements. This is shown in almost all the chapters in which the various public health services are surveyed. Thirdly comes the influence of certain great personalities, both medical and lay, to whose initiative and activities the author pays tribute. It is well that the public should be reminded of these men and informed, even though very succinctly, of their life and work. There are portraits of some: Sir John Simon, Medical Officer of Health, City of London, 1848–55; Sir Donald Macalister; Sir William Osler; Sir Robert Philip; and Sir Robert Morant. Sir George Newman's book is alike an interesting history, a guide to the principles which should influence future developments, and a work of reference. The volume should be welcomed as one of much importance and value.

THE THEORY OF NUMBERS

An Introduction to the Theory of Numbers By Prof. G. M. Hardy and Prof. E. M. Wright. Pp. xvi+404. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 25*s*. net.

THE theory of numbers has an appeal to general interest, not shared by other branches of mathematics, in that most of the great unsolved problems of the subject are formulated in terms intelligible to everybody. There must be many people of limited mathematical attainments who have felt attracted to the subject, but whose interest has died away for the want of just such a book as this to stimulate it.

The point of view from which the book is written can best be described in the authors' own words.

"It is not in any sense (as an expert can see by reading the table of contents) a systematic treatise on the theory of numbers. It does not even contain a fully reasoned account of any one side of that many sided theory, but is an introduction, or a series of introductions, to almost all of these sides in turn. We say something about each of a number of subjects which are not usually combined in a single volume, and about some which are not always regarded as forming part of the theory of numbers at all. . . . We have often allowed our personal interests to decide our programme, and have selected subjects less because of their importance (though most of them are important enough) than because we found them congenial and because other writers have left us something to say."

There can be no doubt that the authors have carried out their programme with marked success. In spite of their modest disclaimer, the book is really as systematic as any elementary account of so extensive a subject can be, or ought to be. It presupposes, for the most part, no more knowledge of mathematics than is possessed by a first-year university student, and yet it introduces the reader to almost all branches of the theory of numbers, including some which have only been developed in recent times. Naturally, in some branches, the deeper results have to be stated without proof; but the book does contain proofs of practically all theorems that are genuinely elementary (using the word in its non-technical sense). Mathematicians of all kinds will find the book pleasant and stimulating reading, and even experts on the theory of numbers will find that the authors have something new to say on many of the topics they have selected.

The selection of topics, and the general approach to the subject, have a slight analytical bias, as will be seen from the list of contents. The reader is introduced at the outset to the O, o and $\sim$ notation of modern analysis, and later to the notions of 'almost all integers', 'sets of measure zero', and 'uniform distribution'.

Each chapter is a model of clear exposition, and the notes at the ends of the chapters, with their references and suggestions for further reading, are invaluable. The only points in the book which the reviewer feels any inclination to criticize are (1) the section on integral quaternions, where the exposition of Dickson has been preferred to the more elegant theory of Hurwitz; (2) the definition of a convex area, which is obscured by the mention of a convex *curve* (a convex area or body is a much simpler thing than a curve, let alone a simple, closed, continuous curve); (3) the absence of an explicit theorem on the existence of primitive roots (mod p).

The printing is excellent, and has not that squashed appearance which is such a common fault of present-day English mathematical printing.

In the following summary of the contents, chapters which deal with the same side of the subject are grouped together.

Chapters i, ii, xxii (first half): the series of primes. A fairly complete account of what is known and what is conjectured about the distribution of the primes, with proofs where these are of an elementary character.

Chapters v, vi, vii, viii: congruences. The classical elements of the theory of numbers.

Chapters iv, ix, x, xi, xxiii: Diophantine approximation. Accounts are given of decimals and continued fractions, proofs of the transcendence of e and π, and three proofs of Kronecker's theorem.

Chapters xii, xiii, xiv, xv: quadratic fields. A few particular fields are treated, and the field $k(\sqrt{-3})$ is used to prove the insolubility of the equation $x^3 + y^3 = z^3$ $(xyz \neq 0)$.

Chapters xvi, xvii, xviii, xxii (second half): arithmetical functions. The formal properties of various arithmetical functions are considered, together with the associated Dirichlet series, also the order of magnitude, average order of magnitude, and normal order of magnitude of some of them.

Chapters xix, xx, xxi: additive theory. One chapter is devoted to partitions, one to representations by two or four squares, and one to Waring's problem. The chapter on partitions is one of the most attractive in the book.

Chapters iii, xxiv: geometry of numbers. Minkowski's theorems on lattices and linear forms.

H. DAVENPORT.

STATISTICAL MECHANICS: ANCIENT AND MODERN

The Principles of Statistical Mechanics

By Prof. Richard C. Tolman. (International Series of Monographs on Physics.) Pp. xix + 662. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 40*s*. net.

NOT so long ago, statistical mechanics was almost synonymous with the somewhat arid topic of the dynamical theory of gases, but the development of the quantum theory has vastly increased the number of subjects which can be treated by statistical methods. Nowadays statistical mechanics deals with the properties of matter in its widest sense, and there has been a steady stream of books concerned with the applications. But although the great development of the subject has been mainly due to the success of the quantum theory in dealing with the interactions of atoms and to the introduction of the Fermi-Dirac and Einstein-Bose distribution functions, yet the repercussions upon the foundations of statistical mechanics have been not less important. So far this part of the theory has been almost completely neglected; Prof. Tolman's important book is meant to fill this gap, and it leaves off where most books begin. The word "principles" in the title of the book does not mean that the book is an introduction to the subject—far from it—but that it is concerned with the logical development of the fundamental principles.

The student of the foundations of statistical mechanics has always been in a rather difficult position. The subject is by no means an easy one, and the presentations given in the classic treatises differ so widely that it requires profound thinking to be able to see that they refer to the same subject. Further, there is no systematic account of the foundations of quantal statistical mechanics (the topic is dismissed in a few pages in the modern treatises on the applications), and the student usually gives up the task of reconciling the various accounts and contents himself with learning to use the distribution laws and to calculate partition functions.

Of the various possible ways of developing the subject, Prof. Tolman adopts that favoured by Gibbs, and discusses the properties of ensembles of systems. This has the advantage that the treatment of quantal statistical mechanics is analogous to that of classical statistical mechanics; indeed in the book the classical theory is given in Chapters i–vi and the quantal treatment in Chapters vii–xii, corresponding chapters having almost identical titles. Now, although Gibbs's method is most satisfying to pure mathematicians in that all the necessary assumptions can be very easily introduced and the whole theory developed in a very logical manner, yet it has always seemed to many physicists to lack that physical plausibility which gives a feeling of life to a subject. Gibbs himself gives to the not too inquiring reader the feeling that statistical mechanics is not concerned with real things. For example, the only justification which Gibbs gives when introducing the canonical distribution ("Elementary Principles in Statistical Mechanics", p. 33) is that this distribution "seems to represent the most simple case conceivable, since it has the property that when the system consists of parts with separate energies, the laws of the distribution in phase of the separate parts are of the same nature—a property which enormously simplifies the discussion, and is the foundation of extremely important relations to thermodynamics". He does indeed show later on, almost at the end of the book, that the familiar thermodynamic equations can be derived from his statistical mechanics, but to many physicists this is very like putting the cart before the horse; they feel that a better procedure is to put thermodynamics right in the forefront of the theory and to deduce the statistical temperature and entropy in as direct a manner as possible. This method of exposition, however, often loses much of its force because the empirical temperature is taken as an intuitive idea instead of being defined thermodynamically as a function of the state of a body which is the same for all bodies in thermal equilibrium with one another. In the reviewer's opinion, the ideal exposition would be one in which this latter more physical approach is introduced at the beginning, while Gibbs's method is used for the subsequent developments.

Those of the 'physical' school of thought will feel regret that Prof. Tolman has chosen to follow Gibbs, but it will be regret tempered by pleasure in that Prof. Tolman's exposition goes a long way towards removing many of the objections to the method. As one example of this we may quote the full discussion of the relation between the canonical and the micro-canonical ensembles and of the justification for using the canonical ensemble. The plan of the book is as follows. Part 1 deals with the classical theory, and, after chapters on the Hamiltonian theory of general dynamics and on statistical ensembles, the Maxwell distribution

law is derived and Boltzmann's H-theorem is proved. The discussion of the latter topic is much more detailed and precise than is usually given.

Part 2, on the quantal statistical mechanics, is the most important part of the book. It is, however, marred, in the reviewer's opinion, by the inclusion of an exposition of quantum mechanics occupying about 150 pages. Most of this is quite irrelevant, breaks the continuity of the book and expands it into a volume which is too bulky. There would perhaps have been a good deal to say for the inclusion of some general theory starting from a fairly advanced point, since some of the results required are not readily available in a convenient form, but discussions of such topics as one-dimensional collisions and the hydrogen atom are quite out of place. The writer of a book such as this must assume that his readers are well versed in the elements of quantum mechanics and, in all probability, in the more advanced theory also. If they are not, they will find the going rather heavy. As in Part 1, the main objects are the derivation of the distribution functions and the proof of the H-theorem. Part 3 deals with the relation of statistical mechanics and thermodynamics.

The book has been most carefully and, for the most part, well written, but the reviewer found himself sometimes fogged by the wealth of explanation. In dealing with a difficult subject, it is by no means easy to know how much explanation to give, since over-exposition is almost as bad as under-exposition, but the book would probably be improved by being shortened. It is, however, a valuable addition to the literature, and will be indispensable to those who wish to understand the principles of statistical mechanics, especially of quantal statistical mechanics.

A. H. W.

GROWING-POINTS OF ORGANIC CHEMISTRY

The Chemistry of the Carbon Compounds

By Victor von Richter. Edited by the late Prof. Richard Anschütz. Vol. 2: The Alicyclic Compounds and Natural Products. Translated from the twelfth German edition (compiled by Prof. A. Butenandt, Dr. M. Lipp, Dr. K. Niederländer, Prof. F. Reindel and Dr. F. Rochussen) and revised by T. W. J. Taylor and Dr. A. F. Millidge. Third edition. Pp. xiii+656. (Amsterdam: N.V. Uitgevers-Maatschappij "Elsevier", 1939.) n.p.

IN his introduction, Mr. Taylor explains that this book is a translation and revision of the first part of volume 2 of the twelfth edition of Richter-Anschütz's "Chemie der Kohlenstoffverbindungen", the German original of which appeared in 1935. The closely related fields of work here selected for treatment are of the first importance in modern organic chemistry. Section A, comprising about 350 pages, deals with alicyclic compounds, and discusses in the first instance such fundamental matters as the formation and stability of ring structures, ring transitions, and general methods of preparing alicyclic compounds. The detailed consideration of monocyclic compounds is then taken up, ranging systematically from the *cyclo*-propane group to compounds containing 34 carbon atoms in the ring. The succeeding description of polynuclear alicyclic compounds embraces rings directly united and those separated by a chain, spirane structures, condensed cyclic systems, and bridged rings. Terpenes and resins are then treated under the headings of olefinic terpenes, monocyclic terpenes, bicyclic terpenes, and sesquiterpenes and polyterpenes.

Section B, comprising the rest of the book, is devoted to the successive consideration of various classes of important naturally occurring compounds, including glycosides, tannins, lichen acids, the active principles of the peppers, natural colouring matters, nitrogen-free poisons, sterols, bile acids and scymnol, vitamins, and hormones.

In the preparation of this valuable edition the original authors revised their contributions to the German edition, and the English translation was subjected to a final revision by Mr. Taylor and Dr. Millidge, with assistance from Prof. A. R. Todd, Dr. S. G. P. Plant, and others. The result is a reliable and surprisingly detailed and up-to-date account of a vast and ever-growing region of organic chemistry. So far as the reviewer has put the text to the proof, the important advances of the last few years in these many fruitful fields of endeavour find here an admirable presentation. As a compact and yet comprehensive work of reference the volume will be of outstanding value to specialists and research workers in the many subjects of which it treats. The continued references to the *Zentralblatt* which formed a somewhat irritating feature of earlier editions of Richter-Anschütz have been happily replaced by direct references to the original papers, including the names of the authors. The text and formulæ are well printed, and there is a good subject index of fifty pages.

JOHN READ.

THE MORPHOLOGY OF THE FLOWER

Floral Morphology

A New Outlook with Special Reference to the Interpretation of the Gynæceum. By E. R. Saunders. Vol. 2. Pp. xiv+133–609+vii. (Cambridge: W. Heffer and Sons, Ltd., 1939.) 10*s*. 6*d*. net.

THE first volume of Miss Saunders's review and summary of her studies on floral morphology was published in 1937 and was reviewed in NATURE of July 24, 1937, p. 132. The second volume is much larger in size and higher in price. Its pagination continues from that of volume one.

In the first volume the author outlined the essential structure of the flower and explained the theory of carpel polymorphism. This, with various consequences of its acceptance, was exemplified by details of a limited number of families (thirty-nine) and selected genera within the families. The general aim was "to serve as a guide to the study of types in the laboratory".

The second volume brings the number of families described up to 190, that is, the vast majority of families of Angiosperms are considered in greater or less detail. The families were, in the first volume, arranged in a sequence adapted to a scheme of laboratory work; in the second volume the arrangement is more taxonomic. The taxonomist would have preferred that the sequence throughout had been according to one of the widely recognized taxonomic classifications. The inclusion of what appears to be a very adequate index largely recompenses for the peculiarities of arrangement.

Miss Saunders has, since 1923, published a large number of papers dealing with floral morphology and especially with that of the gynœcium. She has emphasized the relation of the vascular ground-plan to the floral ground-plan. The fundamental principles of her interpretations are briefly recapitulated in a two-page introduction to the present volume.

Typically and most simply a single vascular bundle turns out from the central cylinder of the axis, traverses the cortex, and is continued into the corresponding floral member as the midrib. Lateral branching may or may not follow or precede exsertion. Thus there depart from the central axial cylinder bundles corresponding in number and in radial disposition with the number and arrangement of the floral members. Owing to space conditions of the short receptacle, fusion, breaking-up, degeneration, or loss of vascular strands may occur and result in complications, yet "the formation of whorls of midrib bundles and their correspondence with the whorls of floral members is a fundamental feature of floral construction and the fact that these midrib bundles originate on definite radii provides a means of determining the number of members in a whorl".

A study of the vascular system of flowers, together with a consideration of various morphological features, many of which have long been known and have puzzled morphologists, led Miss Saunders to accept and expound the theory of carpel polymorphism. In an appendix (pp. i–vii), under the title "A Century's Challenge to Orthodoxy in Ten Chapters", she shows that various botanists had long ago proposed, at least for special or limited groups, interpretations of flower structure definitely or by implication in agreement with the theory of carpel polymorphism.

A very great deal of the present volume is quite 'orthodox'—is indeed descriptive in the ordinary taxonomic sense. The theory of carpel polymorphism is, at present, heterodox, but has now been so lucidly stated with a wealth of examples that floral morphologists who remain orthodox, or who favour some other heterodoxy, must feel they have to meet a challenge worthy of their best efforts.

The need for a reconsideration of morphological concepts and terminology, especially of the flower, is now widely recognized, partly owing to Miss Saunders's own published researches. If agreement could be reached among morphologists and anatomists on the interpretation of the major facts there is no doubt that the conservative taxonomist would, in time, revise his descriptive methods. At present he is somewhat confused by a multiplicity of views. He is told, by different authors, that carpels are leaves, that they are branches, that they are organs *sui generis*, that they are all of one kind, that they are of several kinds, or even that they do not exist. For the present, the taxonomist would be wise to use, so far as is reasonably possible, only neutral terms and phrases, that is, descriptive terms and phrases the use of which does not imply acceptance of any 'explanatory' theory.

It is somewhat disappointing that in this volume Miss Saunders has not published an account of the relationships between the theory of carpel

polymorphism and floral evolution. It would be interesting if she could connect up divergence of carpel form with possible phylogenetic lines and developmental tendencies. Does carpel polymorphism help in interpreting 'convergence', 'parallelism', 'reticulation' and other supposed modifications of what is often considered the ideal type of phylogenetic tree? Does the theory support the view of a monophyletic origin of the Angiosperms? Does it give new or detailed suggestions as to the nature of 'primitive' carpels? Again, it is probable that in the course of her work Miss Saunders found cause to criticize not only the morphology but also the taxonomy of the taxonomist. He would welcome her criticisms. There really seems to be a need for a third volume of floral morphology.

W. B. TURRILL.

INTRODUCING HUMAN ANATOMY

The Tissues of the Body

An Introduction to the Study of Anatomy. By Prof. W. E. Le Gros Clark. Pp. xi+372. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 15*s*. net.

OF late years there has been a rather depressing spate of books that purport to be introductions to the study of anatomy. For the most part these works tend to recapitulate the type of book that was formerly addressed to nurses or students of massage but which is now dished up for the benefit of the medical student. As such they are symptomatic of what in the United States has been termed "the eclipse of Anatomy" and are the outcome of the present tendency to abbreviate the medical student's course in the study of human anatomy. They can only be classed as the products of expediency in a period during which the teaching of anatomy to medical students is definitely undergoing eclipse. If the student is to have his study of anatomy curtailed in an overcrowded curriculum it is but natural that the text-books read by a former generation may prove to be beyond his capacity and his needs.

It is merely a question of relative values. There are those who still fancy that the time devoted to anatomy by the student of some forty years ago was not altogether wasted in the education of a practitioner of medicine.

There are those who think that some three hundred hours are sufficient for learning as much of the intricate structure of the human body as is necessary for one who is afterwards to treat the derangements of this complicated structure. Maybe there were those of an older generation who attached too much importance to the minutiæ of structure and a swing back of the pendulum is but natural. In any event, we have to realize that the present tendency is to reduce the time devoted to the study of anatomy and so to render, for the medical student, the older masterpieces of descriptive anatomy redundant in his library. It is this state of affairs that has produced a host of minor books to meet the lessened need of knowledge demanded from the medical student: and these books are mostly the products of authors to whom the production of a more complete and authoritative work would prove a matter of some embarrassment.

It is therefore an occasion of some satisfaction to meet with a book, written designedly as an introduction to the study of human anatomy, that does not presuppose a lowering of the standard of the student's knowledge and one that is written without an eye to minimum requirements in the medical curriculum and in the examination room. Moreover this book is not the product of one to whom the production of a mere introductory handbook could be pictured as the maximum scientific enterprise. Prof. Le Gros Clark has, in this volume, adopted an almost Hunterian outlook, and in reading his book one is tempted to think that it is only a matter of time before another British anatomist pays open homage to an older tradition in British anatomy and so helps in a renaissance—long overdue—that would end the period of "the eclipse of Anatomy".

The "Tissues of the Body" is not a work on histology, for Le Gros Clark, like Bichat, treats of tissues as the basis of animal organization: moreover he treats of them, so far as present knowledge permits, as living and functional elements. It may be permitted for a reviewer to regard this book as one of the most welcome contributions that has been made to the science of anatomy for many years and to express the hope that it will replace, on the shelves of the medical student's library, several minor works that at present appeal to him under the guise of being introductions to this subject.

F. WOOD JONES.

ARCTIC PLANTS IN THE BRITISH ISLES

BY DR. NICHOLAS POLUNIN, HERBARIUM, UNIVERSITY OF OXFORD

[*N. Polunin.*

TYPICAL ARCTIC TERRAIN IN SUMMER: AN INLAND VALLEY IN SPITSBERGEN. PERENNIAL PATCHES OF SNOW ARE FREQUENT ALMOST TO SEA-LEVEL, A TONGUE OF GLACIER BEING VISIBLE IN THE DISTANCE ON THE RIGHT. THE GROUND IS STONY AND 'BARREN' EXCEPT IN ESPECIALLY FAVOURABLE SITUATIONS, WHERE TRACTS OF MARSH OR HEATH MAY DEVELOP, AS IN THE FOREGROUND AND AROUND THE GRAZING REINDEER IN THE CENTRE

IT is well known that, after the final retreat of the Pleistocene ice in western Europe, the flora of the British Isles was for a time much more like that of the arctic regions of the present day than is now the case. The same must be true of the vegetation and its component plant communities. Following the subsequent amelioration of climate, there came waves of relatively mesothermic dominants before which the smaller and less aggressive microthermic species retreated. The picture is clear and our knowledge of the story seems sufficiently complete. But we still do not know what proportion of the present British flora persisted through the Pleistocene maximum; nor have we investigated the mechanisms which enabled certain plants of 'arctic' affinity to survive in Britain to the present day. My object here is to deal with aspects of this latter problem—in a manner which I would scarcely dare attempt if I had not spent much of the last decade in various arctic and subarctic lands—first by deciding which plants are to be considered as truly arctic and then by analysing the resultant list of species.

It has always seemed to me that the so-called arctic element in the British flora is grossly exaggerated, since it is allowed to include many species which, even if they persist far north of the Arctic Circle, do so only in regions which are unusually favourable in climate and often actually forested—hence not really arctic at all. A fairer criterion would be to take such a line as the southern limit of the 'outer arctic zone', within which the mean temperature of the warmest month does not normally exceed 5° C.; and since this line in general lies around the 75th parallel of latitude I have taken this parallel as the least unsatisfactory principle of delimitation in the present instance. The result is that my arctic species are in most cases the

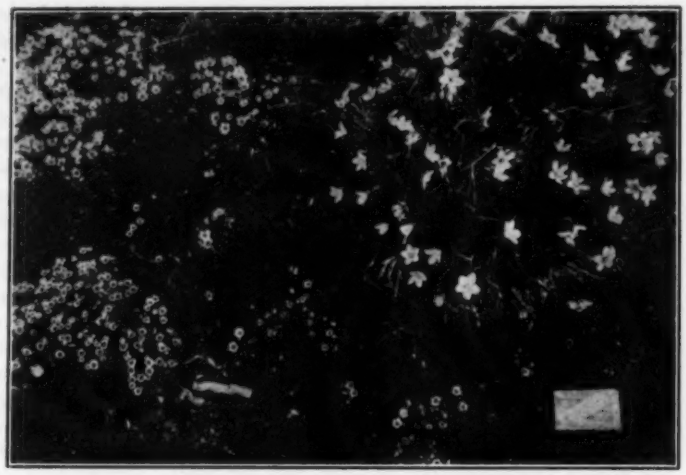
[*N. Polunin.*

AN ARCTIC SEA COAST: DEVON ISLAND IN NORTHERNMOST AMERICA. IN THE FOREGROUND A GLACIER IS DISCHARGING INTO THE SEA. BEHIND ARE POORLY VEGETATED COASTAL PLAINS AND HILLS WITH PERENNIAL PATCHES OF SNOW.

'high-arctic' ones of other authors—whose attempted subdivision of the element according to the supposed history and place of origin of the individual species ought probably to be shelved pending further research.

Altogether, sixty-two species or geographical varieties of vascular plants in the native British flora are now known to persist north of the 75th parallel of latitude and hence to be truly arctic. This is an addition of five (which *just* qualify) to the number of my preliminary analysis[1]; it does not include such aggregates as *Cardamine pratensis*, *Arenaria ciliata*, *Saxifraga stellaris*, *Chrysosplenium alternifolium*, *Matricaria inodora*, and *Carex salina*, which are represented in the north only by a variety that is subspecifically distinct from any form occurring in Britain, and which may accordingly be expected to have different ecological relationships in the two regions. The lower cryptogams present rather different problems and, being moreover much less known as regards distribution, seem best ignored for the present reckoning.

These sixty-two truly arctic vascular plants occurring in the British flora are all perennials. Many of them reproduce chiefly by vegetative means—a tendency which becomes more and more apparent the farther north we go. Classification of the sixty-two according to their most characteristic habitat in Britain, which is almost always comparable if not identical with that occupied in the Far North, gives the following categories and figures.[2]

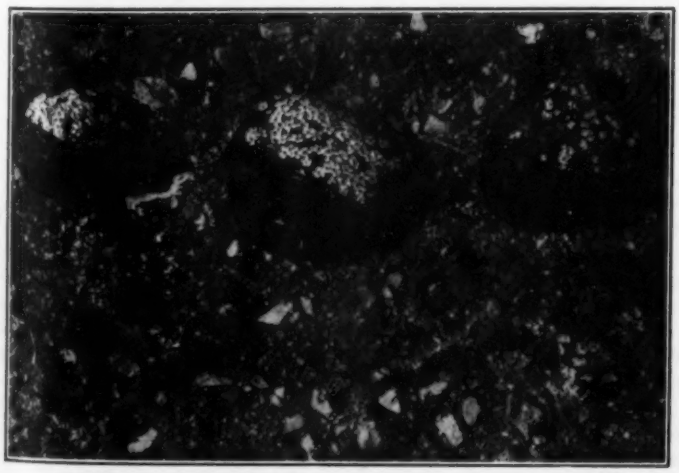


[*N. Polunin.*

A MANURING EFFECT: DENSE MOSSY SWARD INCLUDING *Saxifraga caespitosa* (ON LEFT) AND *S. Hirculus* (ON RIGHT) DEVELOPED AROUND THE NESTS OF WILDFOWL EVEN IN EXPOSED AND OTHERWISE BARREN PLACES, AND INDICATING THAT A LACK OF NUTRIENT SALTS IS ONE OF THE CHIEF FACTORS INHIBITING PLANT GROWTH IN THE ARCTIC. THE SCALE IS SHOWN BY MATCHBOX.

1. *Plants of Open Soil or Rock Crevices*—competition generally negligible whether conditions are predominantly dry or damp. (*a*) Of general arctic distribution including high latitudes (*c.* 80° N.). This category comprises twenty-five species, of which three are frequently to be found also in closed communities. (*b*) Of fairly wide arctic distribution (for example, North Greenland and Ellesmere, or Spitsbergen and Novaya Zemlya). These are represented by eleven species, of which two are frequently to be found also in closed communities. (*c*) Extending far north only in Spitsbergen—tempered by Gulf Stream. Represented by four species, making a total of forty characteristic of open soil or rock crevices.

2. *Plants of Seashore and Lake Margins*—community open, competition again at a minimum. In these habitats are found seven species or varieties which are common to the British Isles and



[*N. Polunin.*

AN ARCTIC 'COMPASS PLANT': *Silene acaulis* IN NORTHERN SPITSBERGEN FLOWERING SO REGULARLY ON THE SOUTH-FACING SIDE OF ITS DOMED TUSSOCKS THAT IT ENABLES A CAREFUL TRAVELLER TO KEEP A VERY GOOD 'LINE'. THE BOUNDARIES OF THE NON-FLOWERING PARTS OF THE TUSSOCKS HAVE BEEN INKED OVER. NOTE THE LACK OF PLANT-COVERING ON MOST OF THE GROUND.

the Arctic, making a total of forty-seven characteristic of open habitats.

3. *Plants Characteristic of Other Habitats* but frequently found in open areas in both north and south. Of these there are eight species, making a total of fifty-five which are to be found in open areas.

4. *Marsh or 'Heath' Plants.* Of these there are seven species.

The more important conclusions to be drawn from these statistics are as follows: an overwhelming majority of the sixty-two native British vascular plants which reach high latitudes grow chiefly in the absence of competition—both towards their northern limit where the vegetation is generally open and towards their southern limit where under natural conditions it is almost always closed. No fewer than forty-seven (75·8 per cent) are plants predominantly of open soil (or rock crevices, which are ecologically similar in that competition is generally lacking), another eight being frequently found in such situations both in the north and in the south (total 88·7 per cent).

Of the seven remaining plants (which are rarely if ever to be found in open areas in the British Isles) I have seen one (*Eriophorum angustifolium*) colonizing damp open soil in the Far North both in Spitsbergen and Ellesmere, and to the south in Iceland, Labrador and southern Greenland; the larger phase of temperate regions may well be taxonomically as well as ecologically distinct. Exactly the same remarks apply in the case of *Calamagrostis neglecta* when Devon Island is substituted for the more northern Ellesmere (where this species is not known to occur). Like *Calamagrostis neglecta*, two more of the five remaining 'marsh or heath' plants, namely, *Rubus Chamæmorus* and *Tofieldia palustris*, reach north of 75° only as depauperated relics eking out a precarious existence in one or two localities in West Spitsbergen where the climate is much tempered by the Gulf Stream, while the remaining three also are characteristically more southern plants which merely straggle northwards in a few favourable healthy areas.

It may accordingly be said that truly arctic vascular plants are usually perennial dwarfs which can propagate vegetatively or flower and ripen seed in the short cool summer obtaining north of 75°, and can endure cold and rapid changes in water-relationships, but are unable to withstand competition. They flourish in the Far North where the communities are generally open; to the south they rather naturally persist chiefly where conditions prevent the growth of ranker dominants, and where the growing season is not too long and warm for their normal metabolism. Thus in the British Isles the majority are rare alpines of rock crevices or other 'open' habitats. It is without doubt only the persistence of such habitats in Britain which has allowed the survival (or perhaps in some cases recent introduction) of so considerable an arctic element in the British flora.

[1] *Proc. Linn. Soc.*, Session 151, 131 (1939).

[2] Names and other details of the individual species and varieties concerned will be published in the *Journal of Botany*, **77** (September, 1939).

WILLIAM SMITH (1769-1839), THE FATHER OF ENGLISH GEOLOGY

ON August 28, 1839, 'Strata' Smith, as he was familiarly known, died at the house of a friend in Northampton. He was on his way to a meeting of the British Association in Birmingham, to which he had been specially invited, but was taken ill before he could continue his journey. Thus passed away, at the age of seventy years, one of the greatest figures in British geology.

Smith's contributions to science are too well known to need more than brief mention here. After establishing that the different rock strata encountered in the course of his work as a land surveyor always occurred superposed in a particular order, he also discovered that individual strata could be recognized by the fossils they contained. He tested these fundamental observations in various parts of England and everywhere found support for his theory. His conclusions, and the extensive observations on which they were based, laid the foundations on which the whole structure of British stratigraphy is built. Further, as has been pointed out by Bather, the recognition of a regular succession of strata introduced the idea of relative time, and without this premiss, no proof of evolution is possible. Thus, it can fairly be claimed that Smith had an indirect though very important influence on the birth and development of the theory of evolution.

At an early date Smith formed the habit of recording his stratigraphical observations accurately on topographical maps. He evolved the idea of showing, by different colours, not only the areal distribution of the various strata, but also their structural relationship, that is, the vertical order

in which they occur. Some of his early maps were exhibited to various societies, but the first to be published was his famous "Delineation of the Strata of England and Wales, with part of Scotland" (1815). This is a large-scale detailed map embodying the results of Smith's labours over a period of some twenty years, and is the first published geological map of England and Wales. Smith was thus one of the pioneers, if not the actual founder, of geological cartography in Britain.

In order to understand how Smith came to make his discoveries, and to appreciate their influence on contemporary thought, some knowledge of his early life is necessary. He came of farming stock, and, in 1787, at the age of eighteen years, he became assistant to a surveyor at Stow-on-the-Wold, in Gloucestershire. Four years later, in 1791, he was entrusted with the survey of an estate in Somerset. Smith records that this was the year in which his first observations on stratigraphy were made, as a result of having been particularly impressed by the regular stratification of the Lias in the latter county. He continued to work in Somerset for some years, and during this period took the opportunity of acquainting himself with the principles of canal construction, a branch of engineering then much to the fore.

Afterwards he obtained an appointment as engineer to the projected Somerset Coal Canal, and Phillips, his nephew and biographer, says "it was the necessity of a close and accurate knowledge of the different sorts of rock, sand, and clay, which were to be cut through on the line of the canal, which led him to examine minutely and scrupulously into the distribution of the 'extraneous fossils' which he had been in the habit of collecting". Work on the canal commenced in 1794, and by 1799, at the latest, Smith was convinced that different strata in the neighbourhood of Bath could be identified by their fossils.

At this time geology had only just begun to establish itself as a separate science, and Smith's discovery was entirely novel, at all events in Great Britain. Yet he was able to support his conclusions with such strong evidence that he had no difficulty in converting to his views two enthusiastic and well-informed local geologists, the Rev. Benjamin Richardson and the Rev. Joseph Townsend. These gentlemen at once realized the importance of his discovery, and induced him to draw up a table of the strata around Bath, from the Coal Measures to the Chalk. This historically important document was copied and widely circulated both in Great Britain and abroad, but, unfortunately, it was not immediately published. As there was no formal publication of Smith's discoveries until a number of years later, his claim to be regarded as their author passed unrecognized except by his intimate friends, and it was long before he received the honours that were his due.

Meantime, Cuvier and Brogniart had begun to study the Tertiary deposits of the Paris Basin, and they arrived at the same conclusions as those which Smith had deduced from an examination of the English Jurassic rocks. Their results were published in 1808, and it is interesting that the same principles should have been discovered independently at approximately the same time in England and France. There is no doubt of Smith's priority, and it is clear that he achieved his results uninfluenced by the ideas of other workers. Whether the circulation of his views had had any influence on the Continent is not known.

Although Smith's claim to fame rests on his pioneer discoveries in geology, it should not be overlooked that he achieved distinction in his profession as surveyor and engineer. For many years his services were much in demand in an advisory capacity for problems of land drainage, schemes for protection from the inroads of the sea, water supply, and canal engineering. In fact, his first publication (1806) was an account of the draining of Brisley Bog, for which achievement he had received a medal from the Society of Arts. His application of geological principles to these problems undoubtedly contributed largely to his professional success. He was always alive to the economic possibilities of his knowledge of geology and his discoveries had an important bearing on, for example, the development of the British coal fields.

Rather surprisingly, Smith never became a member of the Geological Society of London, although he was resident in London for some years after its formation in 1807; and this Society was somewhat slow in affording him adequate recognition. In later life, however, it made him the first recipient of the Wollaston Medal. The announcement of this honour was made in Smith's presence at the first meeting of the British Association, held in York in 1831. He received the medal in 1832 from the hands of Sedgwick, who, in a laudatory address, referred to him as the "Father of English Geology". In 1835 Trinity College, Dublin, conferred on Smith an honorary LL.D.

It is satisfactory to be able to record that suitable honours were accorded to Smith during his lifetime. Later a monument to his memory was erected at Churchill, Oxfordshire, his birthplace; and memorial tablets have been placed on a house occupied by him at Midford, near Bath, and in Bath itself, on the former residence of the Rev. Joseph Townsend, in which he dictated his famous table of the strata near Bath.

V. A. E.

PHOTOGRAPHY IN SCIENTIFIC RESEARCH

A conference was held in Manchester during July 3–4, under the auspices of the Manchester and District Branch of the Institute of Physics, and under the chairmanship of Dr. F. C. Toy, and was devoted solely to photography, with the principal object of giving an opportunity for discussion of the many photographic problems met with in scientific research, where photography plays so large a part. A large amount of time was necessarily given to reviews on the various aspects of photography and its applications, but in the first session fundamental problems of latent image formation were discussed and some original work was reported; this will occupy most of the space available for the present report.

Prof. N. F. Mott opened the session by a "Description of the Photographic Processes in Terms of Atomic Physics", Dr. J. L. M. Brentano, Dr. W. F. Berg and others contributing to the discussion. Dr. S. O. Rawling gave a paper on "Some Theories of the Action of Developers". Much of the matter dealt with has already been reported in NATURE[1] and elsewhere. The latent image which can so far be revealed only by the process of development was assumed to be a small speck of silver. Modern atomic theory enables a more detailed model of the flocking together of the isolated silver atoms formed by light to be given[2]. The silver halides are photo-conductors, that is, mobile electrons are formed if light is absorbed. The silver halides are also electrolytic conductors: some silver ions (in 'interstitial' positions) will move through the crystal if an electric field is applied. Thus, if there is a place in the crystal where electrons can be collected and held 'trapped', a field will be set up and the ions will move up and neutralize the electrons, thus forming metallic silver. A piece of silver in contact with silver halide constitutes such an electron trap. In this way, once a small speck of silver is formed it will continue to grow if light is absorbed by the crystal. During that process the halogen atoms must escape, otherwise a regression would occur. It is important that in the model suggested the halogen will escape through the crystal surface and will not be liberated at the interface of silver and silver halide. The depth of the electron traps can be determined optically by the Herschel effect: red light will release electrons from the traps and thus bleach the latent image. Thermal energy would not be enough to release electrons, and thus a silver speck in contact with silver halide is stable.

The migration of atoms through solid bodies by a process in which electrons and ions move separately, is a fairly general phenomenon. It occurs, for example, in the atmospheric oxidation of metals, as is shown by the dependence of the rate of that process upon the oxygen pressure[3]. A similar mechanism is responsible for the thermal disintegration of certain azide compounds at 100° C.[4].

To understand the formation of the photographic latent image itself it is necessary to assume the existence of an electron trap before exposure. This probably consists of impurities like silver sulphide, the so-called sensitivity specks[5]. A very small silver speck is considered to be not as stable as a larger one; electrons and ions may 'evaporate' from, and thus break up, a small speck[6]. This process was regarded as responsible for the 'reciprocity failure' at low intensities; at constant exposure (intensity × time) the density depends on the intensity level, because at low intensities a speck may partly evaporate, and thus be too small to make the grain developable, whereas at higher intensity the speck reaches a stable size more quickly without losing matter by evaporation.

Some of the experiments reported by Dr. Brentano appeared to require at least some qualification of this picture. These experiments were made on diluted emulsions, thus avoiding the complications due to the multi-layer nature of commercial materials. The shape of the foot of experimental characteristic curves required the assumption that a grain must absorb 10 or more quanta to be made developable. This is of importance for the consideration of low intensity reciprocity failure and suggested experiments in which a certain exposure was given in a few instalments, with varying intervals of time in between. Below and near the threshold, exposures were additive, even when separated by intervals up to 300 hours. Thus, a markedly stable result is obtained already at the very first stages of an exposure. At higher densities, an interruption of an exposure causes a regression, which is greatest where the characteristic curve is steepest. For small exposures an interruption after $\frac{1}{4}$, $\frac{1}{2}$ or $\frac{3}{4}$ of the exposure has been given causes the same amount of regression. Several breaks even when close together cause a larger regression than a single break. These findings might be accounted for in two ways. One is to assume that the last electron or ion joining a growing speck is for some time in a less consolidated state. The other is to

modify the assumption of the small specks breaking up and getting lost by a hypothesis introducing a certain delay in the early stages of latent image formation.

Two groups of experiments were made with the intention of showing whether such a delay could be due to a process of temporary trapping of electrons outside the latent image. Experiments in which exposures to light of different wave-length, balanced to produce the same density for the same time of exposure, were added, showed a small but distinct difference in density if the order of the exposures was reversed; this was interpreted as demonstrating a small amount of trapping[8a]. An X-ray examination of the state of crystalline perfection of a number of emulsions showed that in general the more sensitive emulsion grains are subdivided into smaller crystallites as indicated by the broadening of the X-ray lines. Another possible interpretation is the existence of a bigger strain in the more sensitive grains. As a particular instance it was mentioned that sensitizing by mercury vapour produced such a broadening. This may be cause or part-effect of the increase in sensitivity.

Reciprocity failure has been shown to be, at least to some extent, a development effect, the rate of development depending on the intensity of the exposure[9]. This effect has not been explained satisfactorily, requiring a deeper insight into the mechanism of development.

The process of development may be explained by a mechanism similar to that of latent image formation, the developer being regarded as a medium that will hand over electrons to the latent image. Thus, a field will be set up, and interstitial silver ions will move through the silver halide. For this process to work, the developer must come into intimate contact with the silver speck. The difference in adsorption between various agents, which might otherwise be suitable as developers, may be regarded as responsible for the differences in their behaviour. Another point of view considers the reduction of the silver to occur in the solution, which soon becomes supersaturated and deposits silver on to the latent image. Since the solubility of silver halides in ordinary developers is low, this is probably not the most common process. According to still another view, the silver speck is only incidental to latent image formation, which is considered as being the removal of some of the surface charge of the grains. This charge ordinarily inhibits contact between the developer and the grain, but when it is removed, contact becomes possible.

The Gurney-Mott theory[2] has given rise to a series of papers undertaken to test that theory. Application of low temperature seemed the obvious means of doing this, since ionic movement is then slowed down or arrested. The experiments lead to the following views[9]. At low temperatures free electrons are formed and then trapped, partly in the sensitivity specks, partly in other less stable trapping centres in the grain. The depth of the traps could be investigated by releasing the trapped electrons by red and infra-red light. Ionic movements occur on warming up only and depend solely on the total number of electrons trapped, which in turn depends only on the total number of quanta absorbed. Thus, no reciprocity failure should occur at these temperatures, as has actually been shown[10,11]. These experiments, while compatible with the Gurney-Mott theory, cannot be regarded as proving it, since several additional hypotheses were required for their explanation. The value of the theory as a working hypothesis that had given new stimulus to research into photographic problems was stressed.

Mr. E. R. Davies's paper on "Some Important Properties of Photographic Materials" in which the basis for many applications of photographic methods in scientific research were given, and the advantages and dangers of these methods pointed out, was given in his absence by Dr. Berg[12]. Mr. C. W. Bradley, Dr. J. G. Wilson, Dr. C. A. Adams, Dr. C. A. Bruck and Prof. W. H. Lang then gave examples of the application of photographic methods to specific problems. The three principal advantages of the photographic method lie in the high amplification factor of about 10^{10}: a few quanta striking a grain make the whole grain developable; in the possibility of integrating weak light over long periods—in astronomy the photographic method enables stars to be detected that are ten times weaker than the weakest detectable by the eye; and finally, in the possibility of recording radiation outside the visual range. Some of these advantages have to be paid for; the granular structure leads to loss of resolution due to the graininess and the scattering of light causing 'image spread'. This, however, may sometimes be useful: stellar magnitudes can be determined by the spread of the pin-point images. Many difficulties arise from penetration and exhaustion effects during development, making photographic photometry a difficult problem.

This is further complicated by reciprocity failure, intermittency, and wave-length effects, so that photometry should be based solely on the matching of densities produced by exposures of the same duration and the same degree of intermittency, to light of the same quality and on the same piece of photographic material. Furthermore, the density should be constant over not too small an area. As a beautiful example of this, was mentioned the method of street lighting photography developed in the G.E.C. laboratories[13].

During an evening session, to which a much wider audience had been invited, Dr. D. A. Spencer gave an account of present-day colour photography, illustrated by a cartoon film. This lecture was very much appreciated, and the large attendance showed the widespread interest created. The whole of the conference was very well attended, and the discussion was often very lively, demonstrating the need of informal meetings of this type, in which the aim is partly to bring forward new pieces of research, but partly also to relate already published information of the type not easily accessible to the physicist in industry. The hospitality and general arrangements provided by the Physics Department of the University of Manchester were very much appreciated by all participants.

W. F. BERG.

[1] NATURE, **140**, 997 (1937).
[2] Gurney and Mott, *Proc. Roy. Soc.*, A, **164**, 151 (1938).
[3] Wagner, *Z. phys. Chem.*, B, **21**, 25 (1933).
[4] Papers by Garner, Wischin and Mott, *Proc. Roy. Soc.* In the Press.
[5] Sheppard, *Phot. J.*, **65**, 380 (1925).
[6] Evans and Webb, *J. Opt. Soc. Amer.*, **28**, 431 (1938).
[7] Webb, *Phot. J.*, **76**, 78 (1936).
[8] Strock, Skrifter utgitt av det Norsk Videnskaps-Akademi i Oslo, (I) Mat.-Naturv. Klasse, No. 10 (1938).
[9] Berg, *Trans. Farad. Soc.*, **35**, 445 (1939).
[10] *ibid.*, footnote, p. 458.
[10] Berg and Mendelssohn, *Proc. Roy. Soc.*, A, **168**, 168 (1938).
[11] Evans and Hirschlaff, *J. Opt. Soc. Amer.*, **29**, 164 (1939).
[12] Much of the matter of this lecture may be found in Ross, "The Physics of the Developed Photographic Image" (New York, 1924).
[13] Hopkinson, *Phot. J.*, **76**, 323 (1936).

OBITUARIES

Prof. J. Mellanby

THE death of Prof. John Mellanby on July 15 at the age of sixty years takes from us not only a great physiologist but also a notably genial and kindly personality. He will long be remembered by his colleagues and his students for his penetrating wisdom as well as for his ever-ready willingness to help.

Mellanby went up to Emmanuel College, Cambridge, in 1896 and took Part II of the Science Tripos in 1900, having been an early student under Gowland Hopkins, who had just begun to teach biochemistry at Cambridge at that time. From Cambridge he went to the research laboratory newly founded by Burroughs and Wellcome at Brockwell Hall, and worked there chiefly on the properties of serum proteins and their relation to antitoxins. He left there to complete his clinical course at Manchester and took his M.D. at Cambridge in 1907 and returned to the Cambridge laboratory as George Henry Lewes student. He was still engaged on protein solutions, and in particular on the phenomenon of clotting in blood and milk.

In 1909 Mellanby left Cambridge to take charge of the Physiological Department of St. Thomas's Hospital and began to use the measurement of the clotting-time of milk as a sensitive method for determining the quantity of active trypsin in pancreatic juice, and thus to work out the details of the formation of trypsin from trypsinogen. From the properties of the juice he went on to elucidate the mechanism of its secretion, and it is perhaps his work on this and on the purification of secretin which, together with his earlier investigation of clotting, form his best-known contributions to knowledge.

Mellanby became a fellow of the Royal Society in 1929 and at the time of his death was a member of its Council and of the Medical Research Council. But his purely physiological work was only one part of his activity. What was always in his mind was the encouragement of research from the clinical side, and he was at all times anxious to help, both by advice and in practice, in any problem that might be brought to him. He felt that problems in medicine were problems in physiology and that both were only to be solved by experiment. Such problems arose in the most varied fields and were responsible, for example, for his work with Anwyl-Davies on the anti-coagulant action of arsenobenzol and the making of colloidal gold solution, and with C. R. Box on glycosuria.

In 1937 Mellanby became professor of physiology at Oxford and continued there the work on visceral movement to the study of which he had been led by his work on the effects of secretin. He finished an investigation of the changes in size of the spleen shortly before his death. In Oxford, as in London, he was in close touch with his clinical colleagues and his influence on the future of the Nuffield Foundation would have been of immense value. As a researcher he was outstandingly original and versatile, and it is safe to say that time will enhance his reputation in the fields which he made his own.

V. J. WOOLLEY.

Dr. M. A. Usov

THE death occurred on July 26 of one of the most eminent Soviet geologists, Mikhail Antonovich Usov, member of the Academy of Sciences of the U.S.S.R., and director of the All-Union Institute of Co-ordinated Geological Research.

Usov's work was mainly concerned with questions of tectonics and petrology. He elaborated a new method for the study of the tectonics of coal deposits, making use of the vast materials available from underground workings, to which geologists had until then paid little attention. An analysis of the breaks he had observed induced him to make an exhaustive classification of the forms of volcanic dislocations. This resulted in the appearance of several works on the tectonics both of individual mines and of the entire Kuznetsk Basin. In these works he revealed

the movement of the Cambrian formations from the direction of the Salair mountain range and the movement of the Devonian formations to the River Tom. These works have become standard guides for mining geologists working in the Kuznetsk Basin. Later, Usov extended his investigations to other parts of the West Siberian Territory. He made a thorough study of the phases and cycles of the tectogenesis of the territory from ancient times to the present day, laid down the principles for distinguishing them and surveyed the tectonic history of the region.

In two of Usov's published works on petrology, "Phases of Effusives" and "Faces and Phases of Intrusives" Usov synthesized the research of the most eminent petrographers, also giving the results of his own research, giving geologists working in the field a method for studying these rocks on the spot.

Usov created a big school of geologists at the Kirov Industrial Institute of Tomsk. He was very interested in the popularization of science, and wrote a number of popular works on geology. He was elected a member of the Academy of Sciences of the U.S.S.R. on January 30, 1939.

NEWS AND VIEWS

National Trust, 1938-39

It is significant of the increased interest of the public in Great Britain's treasures of natural beauty and historic interest—an interest that has grown in proportion as the dangers from building-development have increased—that in the last ten years the properties held by the National Trust or protected under covenant have more than doubled; they now total over 80,000 acres. The gross cost of upkeep, improvements and agents' salaries, according to the Annual Report for 1938–39, exceeds £29,000, while the income from letting, etc., of the properties amounts to £24,650, the difference being met by subscription. The new properties acquired in the period June 1938 to June 1939 number 37 and cover 2,965 acres. Among the more interesting or important acquisitions are 81 acres on Dunstable Downs, 224 acres at Hindhead, Surrey, and more than 900 acres of Dovedale and the Manifold Valley. In addition, 25 properties, covering 7,142 acres, were protected by covenant within the period. Extensive areas are now owned or protected in districts which have been mentioned as prospective national parks. In the Lake District, for example, the Trust now owns 12,000, and protects a further 19,150 acres, while on Exmoor it owns more than 9,000, and protects a further 900 acres. Of Dovedale and the Manifold Valley it owns or protects more than 4,600 acres. At present Cornwall has more coast owned or protected by the Trust than any county; but a considerable stretch of coast in Pembrokeshire will be affected by the recent appeal. The activities of the Trust have been greatly increased by the facilities for co-operation with local authorities under the National Trust Act of 1937, which is now working. Local authorities have already contributed large sums towards preservation schemes in their respective areas. One of the more important undertakings of the Trust, at least from the point of view of the archæologist, is the custody of Stonehenge. Here additional fencing has been carried out and the café demolished; but work on the aerodrome is proceeding only very slowly.

Leadership in Democracy

The seventh Walker Trust Lecture on Leadership entitled "Leadership in Democracy" delivered before the University of St. Andrews by Lord Lloyd on November 14 has been issued in pamphlet form (Oxford University Press. 2*s*.). Lord Lloyd insists that leadership is not the art of becoming and remaining a leader, but the art of leading. It is the opposite of dictatorship, inspiring free men with the feeling of moral obligation to follow. It requires will directed to a high purpose, clearly realized and defined, and courageously pursued. The need for leadership in a democracy, moreover, is even more urgent than in other forms of government because democracy as we know it in Great Britain is a new and untried system of government with no legal restrictions of rights on majority opinion. Lord Lloyd attributes the difficulties and dangers confronting us to-day largely to the absence of leaders who are able to inspire and guide the wills of men to the accomplishment of a high and disinterested purpose. Failure to make up our minds to positive action and to educate and enlighten public opinion has involved incalculable risks. The peril of democracy is its own failure to find the leadership necessary to make its high and necessary ideals triumphant in a world where men are neither naturally wise nor naturally virtuous.

The worst sign of our loss of leadership is the tendency to regard democracy as synonymous with this or that piece of political machinery, regardless of whether the machinery is serving or is capable of serving the aims and ideals for which it was set up. Lord Lloyd urges that in a democracy a leader can only lead if he has the courage to be loyal to faith and conscience and to base all his principles upon them. The first task is to set before the people clearly the ends which they should seek and to show how these ends are shaped and determined by the requirements of Christian morality. Peace at home and abroad can only be based on justice, and if we are to play our part in the preservation of liberty here

and its restoration abroad it can only be by promoting a clear understanding of the ends to be pursued and of the kind of society necessary for human well-being. Justice and freedom must first be established before peace can be secured. A peaceful civilization can only be built on a foundation of free men; men subject to misgovernment are no more free men than men subject to a tyranny. We are in danger of losing our great heritage of freedom by surrendering to political expediency, and lack of courage and candour have brought us to the edge of catastrophe.

Damage by Rabbits

THE economic loss to farmers and others through damage caused by rabbits reaches a large annual sum, and it has long been a grievance that much of the damage was done by rabbits bred on adjoining property, over which the sufferer had no control. The "Prevention of Damage by Rabbits Act", passed through Parliament in July, helps to right this state of affairs. It empowers county councils to serve a notice requiring an occupier of land either to destroy his rabbits or to fence them in, and the penalty for non-compliance with such a notice is £25 together with £5 per diem for a continuing offence. County councils are also empowered to provide men and equipment for assisting occupiers to keep down their rabbits, and cyanide fumigation and similar methods of rabbit-control are legalized. The Act also imposes a heavy penalty (£20 for a first offence) for using or permitting the use of spring traps for rabbits elsewhere than in rabbit holes, that is to say, "under the roof" of a rabbit hole. The Bill was promoted at the instigation of the Universities Federation for Animal Welfare, and the secretary of the Federation is prepared to send "Instructions for Dealing with Rabbits" to any person interested who may apply to him at Gordon House, 29 Gordon Square, London, W.C.1.

Ancient Greek Measures and Athletic Records

A REVISED estimate of Greek units of linear measurement would appear to emerge from a study of the records of feats accomplished in the long jump by athletes of ancient Greece in the great festival games. M. Evangelos Kalfarentzos, Inspector-General of Physical Education at Athens, in a communication presented at the conference in connexion with the Lingiad Gymnastic Festival (*The Times*, July 31) arrives at the conclusion that the length of the remarkable jumps attributed to certain famous performers must be computed in terms of a 'foot' which was not uniform in all parts of the Greek world. He bases his argument on the evidence of a comparison of the reputed size of the stadium with the measurements of the various stadia as shown in the results of modern excavations. While it is true that the stadium at Olympia measured 600 'feet', it is an error, M. Kalfarentzos maintains, to hold that all stadia were of this length. Thus the stadium at Delphi was 1,000 'feet'. The actual length of the Delphi stadium was 177·55 metres which, divided by 1,000, gives a 'foot' of 17·76 centimetres. Phaullus, the winner at the Pythian games, as he is named by contemporary writers, is universally accredited with a 'record' jump of 55 'feet' and he is said to have been the first to clear the ditch of soft earth of 30 ft. breadth. Calculated on the revised estimate of the Delphic foot, this jump measures 9·77 metres, or almost exactly 32 feet according to British measurement; while the jump of Chionis, winner at the Olympic games in 664 B.C., is computed at 7·05 metres, or 23 ft. 1 in., on the basis of a 'foot' of which a nominal 600 went to a stadium length, which has been shown to be 192·25 metres.

Further Discoveries in Mycenean Greece

EXCAVATORS on Mycenean sites in Greece during the past season have indeed been fortunate. No fewer than three discoveries of major importance have been made—the inscribed tablets from the "Palace of Nestor", the first from a Mycenean site, which, though later, may throw light on Cretan script, the Mycenean Royal tomb at Athens, and now a Mycenean royal burial, probably of a queen, which has been found by the Swedish Archæological Expedition under Prof. Axel W. Persson of the University of Uppsala at Dendra in the Peloponnese (*Illustrated London News*, August 19). The expedition, which had set out with the intention of excavating at Mylassa in south-west Asia Minor, but was prevented by the political situation, attacked as its second string, the site of Midea, near Nauplia, with which the director was already acquainted, and where he had opened a royal tomb in 1926, finding the gold 'octopus' cup. Midea, according to Thucydides, was a vassal state of the Mycenean rulers.

THE expedition first located the royal palace, and then opened five tombs, one of which, relatively small, contained a beautiful collection of late Mycenean pottery. Three of the tombs were of exceptional size and all had much to offer of interest to archæologists. Three had been more or less stripped by grave robbers; but one of them from an unplundered pit yielded a fine collection of bronzes, knives, swords and cups, while in another were the first known wooden coffin and bronze helmet of Mycenean date. The fourth grave, however, in which the entrance, approached by a dromos of considerable dimensions, had not been touched since it was sealed, contained a wealth of gold and silver objects of great artistic merit, with which no finds in Mycenean Greece since the days of Schliemann will bear comparison. In the smaller of two pits, which contained the badly preserved remains of a skeleton, were golden necklaces, a large gold cup weighing 100 gr., a signet ring of gold, and a number of gold rosettes, rings and pendants. More than two hundred gold ornaments belonged to five necklaces of different types, and there were more than 1,000 pearls of glass paste, and about one hundred of Baltic amber, the first to be known as of Mycenean date. The second pit contained burial gifts, including terracotta and silver vases, and the first known Mycenean spoon. The pottery suggests a preliminary dating of 1400 B.C.

Cornish Promontory Forts

INTEREST in the promontory forts of Cornwall has been much stimulated by the results of Dr. Mortimer Wheeler's excavations in Brittany. One of them, the large and evidently important fort of Trevelgue Head and Porth Island, Newquay, has been under excavation since July 3. Its investigation is being carried on under the direction of Mr. C. K. Croft Andrew on behalf of the Cornwall Excavations Committee. Excavation is still in progress, though much hampered through lack of funds; but the finds reported to date (*The Times*, Aug. 15), ranging from Neolithic to Early Iron Age, fully bear out anticipation of the importance of the site, based partly on its superficial resemblance to Hengistbury Head, Hampshire, partly on the imposing character of its septuple line of defences. The main defences are now assigned to the third century B.C., when there supervened an occupation rich in artistic and metallurgical attainments. The pottery is akin to that of Glastonbury Lake Village, displaying curvilinear and lenticular decoration, as well as naturalistic leaf and vegetable forms. It would appear that in order that the outermost defences should include a native iron mine, they were given an eccentric form. At the back of the sixth, the innermost, rampart was banked the refuse of a considerable Iron Age town. This consisted of houses, or large huts, arranged terrace-wise on the slope rising from the back of the sixth bank to the apex of the island. The best example of a house cleared as yet was occupied from about 200 B.C. to A.D. 100. It is nearly circular and 46 ft. across, the upper sector being sunk two feet deep in the soft slate rock. It shows some fine examples of dry-walling. The wall was probably never more than 4 ft. or 5 ft. high, but it was 6 ft. thick. The roof ran up from eaves which were supported on a ring of external posts, while the span, being too great for early carpenters, was supported by rings of inner posts.

Radio for Short Distances

THE use of ultra-short waves in radio transmission for keeping police cars in touch with headquarters has proved itself of great value. A.R.P. necessities are increasing the demand for this system of communication. There are also a number of uses to which it can be usefully employed in connexion with switching on and off street lamps, water heaters during peak loads, calling air raid wardens and firemen and there would still be space in the high-frequency band for further applications, which are sure to be suggested within the next few years. Had the cost of these installations not been so high the progress made would probably have been more rapid. Sudden changes in the temperature will also encourage the installation of load-controlling equipment. One of its most useful applications is in connexion with fire-fighting. Experience gained in a recent local blackout shows that ordinary telephone communications can break down under the stress of a sudden emergency. The *Electrician* of August 18 says the Post Office has allotted a limited range of frequencies in the ultra-short wave band for police and fire-brigade purposes and that experimental work is being carried out by the Post Office in association with the Home Office to ascertain the possibility of developing local systems of this type. In dealing with emergencies, speed of communication is of the highest importance and wherever it is feasible to provide an effective means by which police, fire-brigade and ambulance headquarters can keep constantly in touch with their mobile units, this should be done.

Broadcasting over the Power Mains

DEMONSTRATIONS have recently been made of the broadcasting of messages over the electric light and power mains. In 1927 the method was conceived by Captain P. P. Eckersley, who, at that time, thought that the B.B.C. should deal with this special transmission. There is no technical defect in the method. For example, a message can be sent from any sub-station to all the consumers with which it is connected. The messages traverse one of the underground mains and get back to earth by a leakage circuit which contains the signalling device. This system has the advantage that it can be applied very readily. It needs no overhead wiring and so is less vulnerable to attack during a war. It could reach the nine million people in Great Britain who are supplied by a company with electric lighting in their homes. If domestic telephones were used, only two million homes would be available. The following objection to the method has been urged by some engineers. It is said that in time of war or civil commotion, enemy agents could easily inject messages into a power mains system and that it would be difficult to locate where they were working until the mischief had been done. Similarly, they might be able to jam any official message to the public. Seeing that power networks are sectionalized it is improbable that pirate messages would reach more than two or three hundred people at most. If a telephone service were used the number of listeners affected would be about the same as with the power mains system. In either case it would not be difficult to devise a method of locating and cutting off the offender. Electric supply engineers are quite enthusiastic about the broadcasting method. Captain Eckersley and Mr. W. B. Woodhouse are urging that a conference of all bodies interested should be called in order to decide, without further delay, what is best to be done.

Vocational Training for Firemen

A BULLETIN, "Vocational Training for Firemen" (Vocational Division Bulletin, No. 199, Trade and Industrial Series, No. 57. G.P.O., Washington, D.C. 10 cents) issued by the Office of Education, U.S. Department of the Interior, gives a general account of the present status of firemen training in the United States, particularly with reference to programmes developed in co-operation with public vocational education. The estimated loss by fire in the United States in 1937 was 285 million dollars, and the growing demands upon the fire service have increased the importance of training all members of fire departments sufficiently to enable them to utilize

the results of technical progress and to apply scientific knowledge in fire-fighting and prevention. Since 1930, the International Association of Fire Chiefs has been responsible for a programme of training and development, and in 1937 fireman training schools were organized in connexion with State programmes of vocational education in twenty-two States, in which 5,441 firemen were enrolled. The training programmes include a system of zone or regional schools for training within a wide area; extension classes, chiefly in connexion with a State college or university; short courses or institutes providing three to five days of instruction annually; and local training programmes in the larger cities. Vocational training agencies appear to be of assistance chiefly in the training of instructors or conference leaders; the organization of instructors' conferences; the supervision of training programmes, particularly in the zone schools; the provision of instruction in practical and technical subjects through extension classes or short courses and the supply of literature for instruction and teaching. The bulletin also discusses the methods of assisting a local fire department in organizing a training programme and the possibilities of co-operation with other agencies. Details of the organization and administration of the Massachusetts zone schools are appended and also of the California programme.

Hygiene and Public Health in India

THE annual report of the All-India Institute of Hygiene and Public Health, Calcutta, recently issued, summarizes the teaching and research work for the year 1937. Statistical investigations on cholera have been pursued; for example, forecasts of epidemics, and research on variations in the chemical structure and antigenic properties of the cholera vibrio. An inquiry into the nature of an obscure disease, epidemic dropsy, has incriminated mustard oil (much used in cooking) as the causative agent, though what constituent of it is responsible still remains to be discovered. An account of the work of the Maternity and Child Welfare Centre is included.

Tuberculosis in Cyprus

THE National Association for the Prevention of Tuberculosis has published an interim report on the incidence and means of control of tuberculosis in Cyprus ("Tuberculosis in Cyprus", by N. D. Bardswell. M. D. Adlard and Son, Ltd., 21 Hart Street, W.C.1. 2*s*. 6*d*.). Tuberculosis was said to be rife in the island and to be increasing rapidly; the assistance of the National Association was requested, and Dr. Bardswell was appointed to conduct an inquiry in the island. A total of 250–300 notifications of pulmonary tuberculosis a year is recorded in a population of some 360,000. If a correct record, this would give a notification rate for pulmonary tuberculosis of less than 1·0 per 1,000 living—not a high rate, for the present rate (1935) for England and Wales is 0·97, and for London 1·27, per 1,000 living. There is reason to think, however, that the notification returns are inaccurate, and do not represent more than one-quarter to one-half of the new cases occurring annually, owing to failures to notify all cases and to inaccuracies in diagnosis. Dr. Bardswell has surveyed the whole island, and the results of tuberculin testing in some districts are given. The report contains a mass of details, and is well illustrated with maps, plans, charts and photographs. It is difficult, however, to gather the actual facts and conclusions from this report of 228 pages, for it contains no table of contents, no index, and no general summary; these omissions should be made good in any further report.

Scientific Uses of Cinematography

THE British Film Institute, 4 Great Russell Street, London, W.C.1, one of the objects of which is to collect and disseminate information concerning the use of films for educational purposes, is engaged in compiling a bibliography on the scientific uses of cinematography. Very few books have been written on the subject and the list will consist almost entirely of references to reports of scientific associations and to articles which have appeared in scientific and film journals. The Institute would be glad to receive any information bearing on the undertaking.

Water Speed Record

SIR MALCOLM CAMPBELL set up a new record for speed on water on August 19 with his motor-boat *Bluebird II* on Coniston Water. The speeds reached over a statute mile in opposite directions were 142·85 and 140·62 miles an hour respectively, the average being returned as 141·74 miles an hour. Sir Malcolm's boat, in the design of which some novel features were embodied, was driven by a twelve-year-old engine intended for practice runs.

Recent Sunspot Activity

THE appearance this week of a large group of sunspots serves as a reminder that the sun is still very active though past the peak of the present 11-year sunspot cycle. This sunspot group, in latitude 13° N., crossed the central meridian on August 21·9 and will pass off the western edge of the disk on August 28. The aggregate area of the component spots on August 18 was 1,300 millionths of the sun's visible hemisphere. Since the last note on sunspots (NATURE, July 15, p. 109) a number of fair-sized spots have appeared of area greater than 500 millionths but less than 1,000 millionths. The respective times of central meridian passage (communicated by Greenwich) are as follows: July $17{\cdot}1^{d}$, $17{\cdot}7^{d}$, $20{\cdot}1^{d}$, $23{\cdot}4^{d}$, August $4{\cdot}3^{d}$, $7{\cdot}5^{d}$ and $11{\cdot}1^{d}$ U.T.

The Night Sky in September

THE autumnal equinox on September 23 brings equality of day and night the world over; thereafter (until December 22) the nights increase their duration in the northern hemisphere. The moon is new on September 13 and full (the Harvest Moon) on September 28. Jupiter is in conjunction with the moon on September 1 and 28: Saturn on September 3 and

(*Continued on p.* 375)

NATURE

SUPPLEMENT

Vol. 144 SATURDAY, AUGUST 26, 1939 No. 3643

SHORT REVIEWS

Anthropology

Singing for Power

The Song Magic of the Papago Indians of Southern Arizona. By Ruth Murray Underhill. Pp. vii+159. (Berkeley, Cal.: University of California Press; London: Cambridge University Press, 1938.) 9s. net.

MISS UNDERHILL here collects some of the songs which are a characteristic feature in the life of the Papago Indians of southern Arizona. The collection is part of a more elaborate study of Papago ceremonial, for which the material was collected in two expeditions undertaken under the ægis of the Humanistic Council of Columbia University, and occupying fourteen months in 1931 and 1933.

The songs are an essential part of the ceremonial ritual which is concerned with every department of daily tribal life, of rain-making, and in the preparation and first drinking of cactus spirit, 'singing up' the corn, war and scalping ceremonial, puberty and the like. It is interesting to note that the man who has taken a scalp, thereby acquiring magical power, is a danger to others. He has to learn a code of behaviour, whereby he may avoid harmful direction of his powers against fellow members of his group.

In addition to a translation, each group of songs has explanatory notes making clear its position and function in life and belief.

The Native Tribes of Central Australia

By Prof. Sir Baldwin Spencer and F. J. Gillen. New edition. Pp. xxiv+671+9 plates. (London: Macmillan and Co., Ltd., 1938.) 25s. net.

A REPRINT of "The Native Tribes of Central Australia" by the late Sir Baldwin Spencer and F. J. Gillen is more than welcome. The original edition appeared in 1899 and has long been out of print. It is now reproduced without change, but with an introduction by Sir James Frazer, to whose inspiration, counsel and friendship Spencer's work as an anthropologist was so deeply indebted.

"The Native Tribes of Central Australia" may without exaggeration be described as the most important ethnographical treatise on a primitive people ever written. Dealing mainly with the Arunta, it included material relating to other tribes of Central Australia, which Spencer did not incorporate in his later books.

Among the author's discoveries, the record of the classificatory system of relationship current among the Arunta, which effectually prevented intermarriage within the 'forbidden degrees', fully confirmed the earlier work of Fison and Howitt in other parts of Australia; but the outstanding achievement of the investigators lay in eliciting that the Arunta were ignorant of the facts of paternity and of the nature of the process of procreation, and in establishing that the totemic ritual was a magical ceremonial for the increase of the totem—plant or animal. Hereby Spencer and Gillen opened up new vistas in the exploration of the primitive mind in its social and religious orientation, and initiated a new conception of the totemic problem, which for so long had exercised the ingenuity of the anthropologist in speculation.

"The Native Tribes of Central Australia" indeed proved to be in a very real sense an epoch-making book.

Biology

Salmacis (The Indian Sea-Urchin)

(Indian Zoological Memoirs on Indian Animal Types, edited by Dr. K. N. Bahl, 7). By Prof. R. Gopala Aiyar. Pp. ix+69+1 plate. (Lucknow: Lucknow Publishing House, 1938.) 2 rupees.

THIS memoir gives an account of a common Indian sea-urchin which is a fairly typical example of the class Echinoidea. The introductory chapter deals with systematics and so with the position of the genus Salmacis among the Echinoderms. The definitions of the various orders of the Echinoidea are given, and with each order a list of the commoner Indian forms. The example belongs to the family Temnopleuridæ, and a key is provided for the separation of the genera of this family. The next nine chapters provide a systematic account of Salmacis under a succession of headings; external characters, skeleton, alimentary canal, cœlom, connective tissues, respiratory and excretory organs, nervous system, receptor organs and reproductive system. The next three chapters treat of the development of the Echinoidea (some of it based on the classical account by Prof.

E. W. MacBride in the "Cambridge Natural History"), the bionomics and directions for practical work.

Thus it will be seen that the book provides a complete manual for the use of the student of zoology. Its exact utility must be tested by experience, but it certainly appears to be full of promise. It is now twelve years since the appearance of the first of the Indian Zoological Memoirs, and this is the seventh to appear. All of them have exhibited a high degree of technical excellence. The present memoir does not fall below this high level, and the only criticism from this aspect is that, in the example submitted for review, the photograph of breeding Salmacis is not well reproduced; it is not up to the standard of the remainder of the illustrations. Zoologists in India owe a debt of gratitude to Prof. Bahl, to whose enthusiasm this series of memoirs is due.

Further thanks and congratulations are due to Prof. R. Gopala Aiyar for the excellent and workmanlike account of this Indian sea-urchin.

The Birds of Tropical West Africa

With Special Reference to those of the Gambia, Sierra Leone, the Gold Coast and Nigeria. By Dr. David Armitage Bannerman. (Published under the authority of the Secretary of State for the Colonies.) Vol. 5. Pp. xliii + 485 + 10 plates. (London: Crown Agents for the Colonies, 1939.) 22*s*. 6*d*.

FACTS mentioned in the preface to Dr. Bannerman's fifth volume bear witness to the success which the work has already attained. It is indeed remarkable evidence of widespread interest in ornithology that so ambitious a publication, dealing with the avifauna of a tropical area, should have sold beyond anticipation—to such an extent that the first volume is almost out of print. The stimulus given to the study of birds in West Africa, and in the African continent generally, must have been great; this is confirmed by the increasing amount of new material which has been reaching the author and has made it necessary to provide for a seventh volume not originally planned.

The present volume covers seven passerine families, of which the warblers account for 121 forms. The admirable coloured plates portray sixty-seven species, in addition to the many illustrations which accompany the text.

Elementi di genetica

Par Giuseppe Montalenti. Pp. vii + 452. (Bologna: L. Cappelli, 1939.) 50 lire.

HERE is an excellent text-book recording the facts relating to every side of genetics; its text is remarkably clear, scientific terms always explained, and its matter is adequately illustrated. A historical consideration of the position in the nineteenth century leads to the full account of Mendel's researches. Then follows the amplification of these, with many new branches, associated with the early years of the present century. The later-discovered chromosome phenomena lead to a clear account of the localization of the genes and the experimental production of mutations. Embryological and physiological sides are sufficiently treated, as are sex, secondary sexual characters and other associated sides. A good bibliography, helpfully divided into sections, and adequate indexes of authors and of subjects complete a well-compiled work. Finally, the price of about 11 shillings as compared with about 25 shillings for a similar text-book in English suggests a wide and desirable circulation among those able to read Italian.

The British Caddis Flies (Trichoptera)

A Collector's Handbook. By Martin E. Mosely. Pp. xiii + 320 + 4 plates. (London: George Routledge and Sons, Ltd., 1939.) 21*s*. net.

THE need for a handbook on the indigenous Trichoptera or Caddis flies has been long experienced by English entomologists. The present work, to a large extent, supplies this desideratum. Its author is well qualified for the task, having been in charge of the collections of these insects in the British Museum for a period of ten years. All the 184 species known from Britain are described, and the letterpress is accompanied by some 633 very clear figures of the venation and genitalia. The descriptions are short and terse and are based on structural features, but little emphasis is laid upon wing-markings.

It is unfortunate that so little is said about the general structure and biology of these insects or about their remarkable larvæ and pupæ, the book being adapted essentially for the identification of the adult insects. Notwithstanding this criticism, a reliable and well-produced volume of this kind can scarcely fail to impart stimulus to the further study of the interesting creatures with which it deals, and English entomologists are under a debt to Mr. Mosely for having written it. The increasing number of workers in the field of fresh-water biology will also find that this book supplies a long-felt need.

Earth's Green Mantle

Plant Science for the General Reader. By Prof. Sydney Mangham. Pp. 322 + 41 plates. (London: English Universities Press, Ltd., 1939.) 10*s*. 6*d*. net.

IT is no doubt a useful and laudable object to explain to the general reader the place in Nature and the importance to man of the plant world. Sir Arthur Hill states in his foreword, "Prof. Mangham has shed such a diffused and widespread light over the Green Mantle of the Earth that the minds of his readers, by a process of mental photosynthesis, should be able to acquire and assimilate vast stores of curious and unexpected information hitherto not fully appreciated." The variety of topics dealt with by the author is, however, so great that one wonders whether the reader will be able to digest this very ample meal.

Prof. Mangham attempts a *tour de force* by endeavouring to deal with every aspect which plant life opens out. Not only, for example, does he give an account of the plants of past ages but he also describes in some detail the rock systems and geological revolutions. It seems doubtful, too, whether the general reader will be able to appreciate fully a history of botany from Aristotle to the present day and a fairly detailed account of the structure of plants, recent and fossil.

The book is very fully illustrated, but one feels that in this respect also the author has been too ambitious. Many of the ecological photographs —excellent in themselves—have lost a good deal of clearness by reduction in size. By a more careful selection of the illustrations as well as by some cutting down of the subject-matter the author's praiseworthy attempt to enlighten the general public on the interest and importance of the plant life would probably be more successful.

Concise Flora of Britain for the use of Schools

With Explanatory Illustrations and Keys to Identification. By F. K. Makins. Pp. xxviii+212. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 4*s*. 6*d*.

IN the preface to this book the author states that its object is to meet the demand for a modern Flora of Britain suitable for use in schools and by beginners generally, and in describing how to use the Flora he claims that its chief use is to enable the student to identify plants for himself. Short descriptions of more than 1,100 species are given, including, therefore, the great majority of aggregate species of flowering plants and ferns found in Britain. Most of the rarities are excluded. The author has wisely refrained from including illustrations which would give a clue to the identity of any plant, and the main series of drawings is intended to illustrate the technical terms given in the glossary. The attention of the young student will very naturally be directed to these drawings, and it is a pity that there is no indication of what they represent except by reference to the glossary.

The synopsis of families follows fairly closely the arrangement adopted in Bentham and Hooker's "British Flora", but for the actual identification of families and anomalous genera an artificial key is provided which is so constructed that the beginner should have little difficulty in referring any plant to its proper family. Keys to the genera of the larger families and to the species of the larger genera are given throughout the book.

The author is to be congratulated on producing in very compact form a book which is sure of a welcome in schools where botany is taught and where students require an easy guide to the identification of the wild plants they are likely to find. The use of the Flora, however, should be supervised by the teacher so that the artificial aids to identification may not lead to a wrong impression of plant affinities.

J. R. M.

Chemistry

B.D.H. Reagents for Delicate Analysis including Spot-Tests

Seventh and enlarged edition. Pp. viii+120. (London: The British Drug Houses, Ltd., 1939.) 2*s*. 6*d*. net.

THE fact that a new edition of the popular and useful publication of the British Drug Houses has been called for annually is sufficient proof of the established position which this book has attained. The seventh edition has been carefully compiled to eliminate four reagents which have not stood up to the test of time, and to include four new reagents, for the determination respectively of palladium, magnesium, manganese and aluminium. The scope of the book, which now runs to 120 pages, has been augmented by expansion of the monographs of some of the more important reagents.

The reagents are carefully described, but it is suggested that if it were possible to represent the formula of each reagent graphically as in the case of acridine hydrochloride the value of the book would be enhanced, particularly to those whose interest now lies mainly in inorganic chemistry. Included in the book are separate leaflets, one describing the B.D.H. spot test outfit and the other the B.D.H. price list of the organic reagents described in the book.

This B.D.H. publication has proved of great value as a laboratory guide not only to analytical chemists but also to all research workers whose activities lead them to conduct delicate analysis. By supplying frequent editions of their book, the British Drug Houses keep abreast of the most recent advances in the field of analysis, render their publication the standard work on this topic, and summarize for the practical chemist much valuable but often scattered information. It is sufficient to say that the B.D.H. book should be available in every chemical laboratory.

Theoretical Qualitative Analysis

By Prof. J. H. Reedy. (International Chemical Series.) Pp. ix+451. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 18*s*.

PRACTICAL manuals on qualitative analysis are many, and usually consist of tables of practical directions with little or no explanation of the reactions underlying the processes used. Reedy's "Theoretical Qualitative Analysis" is one of the few books which seeks to give the student commencing a course of analysis a thorough understanding not only of such reactions but also of the general theories which form the basis of analytical chemistry, and indeed of inorganic chemistry as a whole.

General theoretical considerations form the first half of the book and include important chapters on the ionization theory, in which both complete and incomplete dissociation theories are discussed in an unbiased manner. For the most part, however, the author has based his applications on incomplete ionic dissociation, and in this connexion it is noteworthy that ionic equations are freely used in place of the older molecular equations.

Theories explained in the earlier part of the book are used in the second half in giving a full and clear description of reactions forming the classic group system of analysis for cations and anions. Division into chapters follows the group system, and each chapter contains a wealth of classified information, on the elements, cations, anions and compounds dealt with. Used in conjunction with a practical manual, this treatise should train the student to be a more intelligent and therefore a more efficient analyst.

The Structure and Composition of Foods

By Dr. Andrew L. Winton and Dr. Kate Barber Winton. Vol. 4: Sugar, Sirup, Honey, Tea, Coffee, Cocoa, Spices, Extracts, Yeast, Baking Powder. Pp. xxxiii+580. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 45*s*. net.

THIS volume completes the authors' extensive labours, of which the first, second and third fruits were noticed in NATURE in March 1933, March 1936, and February 1938. The contents are indicated by the title: the method of treatment is congruous with that adopted in the earlier parts. Addenda (pp. xix – xxiii) bring up to date some of the chemical information contained in volumes 1 and 2. To search for printer's errors and other slips would be ungracious and an admission that adequately to appraise a work of this scope and magnitude is beyond the powers of one reviewer at any rate. He has, however, noted that the authors do not appear to have recorded the presence of vitamin D, presumably calciferol, in or on the shell of the cocoa-bean, which has consequently been advocated as a cattle food to increase the antirachitic activity of cows' milk.

The four volumes as they stand now constitute a complete standard work of reference on the subject. Every laboratory concerned with the examination and control of food, with the morphology and chemistry of its natural sources, whether animal or vegetable, with its proximate analysis and detailed chemical composition, will find in "Winton and Winton" an indispensable weapon.

A. L. BACHARACH.

Volumetric Analysis: including the Analysis of Gases

With a Chapter on Simple Gravimetric Determinations. By A. J. Berry. Fifth edition. Pp. vii+196. (Cambridge: At the University Press, 1939.) 7*s*. 6*d*. net.

THE principal part of Berry's well-known work on volumetric analysis remains unchanged in the fifth edition, following the usual division into chapters describing the use of the chief volumetric reagents and including a chapter on the theory of indicators as well as a short section on simple gravimetric analysis. The practical treatment adopted succeeds in its object of going beyond the scope of elementary text-books without entering into the mass of detail to be found in standard analytical reference works.

The chapter on gravimetric analysis contains new sections dealing with the determination of lead and of phosphates; but the most important additions are to be found in the entirely new chapters devoted to modern developments and to the rudiments of gas analysis. The former includes sections on the more important new indicators, on the use of ceric sulphate as a quantitative oxidizing agent, and on direct titrations with potassium iodate, together with practical applications of these and several other new methods. In introducing this particular chapter the author has brought his course of analysis completely up to date.

Systematic Qualitative Organic Analysis

By H. Middleton. Pp. viii+279. (London: Edward Arnold and Co., 1939.) 8*s*. 6*d*. net.

THE title of this excellent book on qualitative organic analysis is fully justified by the contents, in which a remarkable degree of system has been introduced into the tests for single organic compounds. The schemes of analysis and tabulated properties of groups of substances should be of great value to all chemistry students in the final year of an honours course, and it is claimed by the author that particular attention has been given to pharmaceutical students in that rapid methods are given for identifying most of the organic compounds listed in the "British Pharmacopœia". In working through a course based on this book, the student would undoubtedly become familiar with all the operations commonly carried out by the organic chemist, and should acquire a good practical knowledge of many tests and preparative reactions. A feature valuable to supervisors and examiners is found in a list of hydrolysis times of some hundred esters.

Such criticisms as may be made are in a few matters of detail. Thus one cannot agree that acetates, given first of the derivatives of phenols, are the best medium for the identification of monohydric phenols, the acetates of which are generally liquids. Again, in the section on alcohols, melting points of the dinitrobenzoates might well have been given under each alcohol, instead of being referred to under special reagents.

The book contains a short section on the separation of mixtures of organic compounds and concludes with two indexes—one of the processes and one of the substances described.

A Course in Chemical Spectroscopy

By Dr. H. W. Thompson. Pp. vii+86+8 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 6*s*. net.

THIS neat little volume is based on an elementary course in chemical spectroscopy recently introduced at Oxford for undergraduates reading the final honour school of chemistry. Eight experiments have been selected, and although no attempt is made to describe the technical details of construction of the various instruments used, sufficient information is given to enable a student to carry out each experiment successfully under the general supervision of the teacher.

The principal lines in the atomic spectra of the elements are first measured in the visible region, the Hilger constant deviation instrument being instanced as very suitable. The student then passes on to study series of lines in the ultra-violet spectra of elements, and a good knowledge of atomic structure is presumed. Electronic and rotation spectra come next, whilst the sixth experiment deals with the absorption spectra of gaseous molecules, notably hydrogen iodide, chlorine, sulphur dioxide and oxides of nitrogen. One would have liked to see also a study of the absorption spectra of rare earth salt solutions included, in view of the increased attention now being given to this branch of the subject. Perhaps the author will bear this in mind for future editions, which we feel sure will be required. The two last experiments deal with predissociation spectra and the structure of an infra-red absorption band.

On the whole, the experiments have been well selected. The book is tastefully got up, the type and diagrams are clear, whilst the eight photographs have been very beautifully reproduced. Any student who conscientiously completes the course of instruction may be regarded as possessing a sound knowledge of the elements of practical chemical spectroscopy. J. N. F.

The Oxidation States of the Elements and their Potentials in Aqueous Solutions

By Prof. Wendell M. Latimer. Pp. xiv+352. (New York: Prentice-Hall, Inc., 1938.) 3 dollars.

THE contents of Prof. Latimer's book are much broader than might be inferred from the title. Besides giving all the available information on oxidation-reduction potentials in aqueous solutions, carefully and critically sifted and presented on a uniform plan, it includes a great deal of numerical data based on thermodynamic calculations as applied to reactions which are not directly amenable to electrometric measurement. The volume will be extremely valuable to many workers—chemists, physicists and biologists—and it may be cordially recommended to their attention. It is well printed, strongly bound, and very moderately priced.

Introductory Qualitative Analysis

By Prof. Warren C. Vosburgh. Revised edition. Pp. vii+222. (New York: The Macmillan Company, 1938.) 10*s*. net.

"INTRODUCTORY Qualitative Analysis", a revised edition of Cornog and Vosburgh's book under the same title, is an elementary laboratory manual primarily intended for students of a particular university in the United States. The detailed practical instructions, suitable however for general use, include directions for analytical work on a semi-micro scale. Since the author states that qualitative analysis on this modified scale has been carried out at Duke University during the past four years, he might well have taken the bold step of abandoning ordinary scale directions entirely in favour of the new micro methods.

The theoretical part of the book, providing explanatory matter to be read contemporaneously with the practical exercises, covers the ground adequately and includes general chapters on electrolytic dissociation, chemical equilibrium and the theory of precipitation, in addition to a chapter dealing more particularly with the reactions used in qualitative analysis. It appears a defect that only the theory of complete ionic dissociation is presented, but, in general, the explanatory matter is treated with brevity and clearness.

Engineering

Stream and Channel Flow (Hydraulic Graphs and Tables)

By E. E. Morgan. Pp. xxii+240. (London: Chapman and Hall, Ltd., 1938.) 25*s*. net.

THIS manual is a convenient compendium of hydraulic graphs and tables for stream and channel flow, calculated from a modification of Manning's formula:

$$v = M\sqrt[3]{R^2}.\ \sqrt{S},$$

in which v is velocity of flow in feet per second; R, the hydraulic mean depth; and S, the sine of the angle of slope. M is the coefficient of roughness, corresponding to C, the coefficient of roughness in the Chezy formula, $v = C\sqrt{RS}$, which assumes so complex a form in the formula of Ganguillet and Kutter. The reasons for the adoption of the Manning formula, in preference to those of four other prominent authorities, are set out in Chapter xvi. The whole subject of velocity and discharge multipliers is examined at considerable length. The book is devised for ready reference with marginal finger cuts and a central subject indicator. There is also an index. B. C.

Cement and Concrete

By Rahel Friedland. (Written in Hebrew.) Pp. xii+276. (Haifa: Hebrew Technical Institute, 1939.)

THIS book is claimed to be the first Hebrew text-book in its own field, and will answer a real need in Palestine's rapidly developing building industry. It is written by a member of the staff of the Hebrew Technical Institute, Haifa, presumably as a text-book for its own students. Its style and lay-out are simple and straightforward, and the importance of giving adequate attention to industrial application and practice is fully realized.

Part 1 deals with cement, and is mainly devoted to a consideration of Portland cement; mixed, aluminium, and special cements are dealt with briefly, and the corrosion of cement by acids, alkalis and salts discussed. In each case, the composition, manufacture, physical and chemical properties and methods of testing are adequately described.

Part 2 is concerned with concrete, and chiefly with the composition and properties of concrete, particle size and its relation to the quality of the concrete,

the role of water, methods of preparation, the influence of physical factors, specifications for ingredients, and the analysis and testing of concrete.

A summary of Palestinian regulations for building materials and an interesting glossary of Hebrew technical terms are also given.

This book should be found very useful by all interested in the building industry in Palestine, and particularly by those who intend to study this subject in Palestine. It should also be of interest to the philologist, for is it not a miracle that the age-old Hebrew language, used for so long only as a vehicle for prayer and the study of Jewish sacred writings, should to-day be sufficiently revived to enable a scientific text-book to be written in it? N. G.

Industrial Electricity: Direct-Current Practice
By Prof. William H. Timbie. Second edition. Pp. xii+636. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 15*s*. net.

TECHNICAL students and industrial workers who desire to qualify for posts where a knowledge of electrical science is necessary will find this book very helpful as an introduction to the subject. Phrases used in everyday work such as voltage drop, potential gradient, floating batteries, dielectric constant, etc., are not easy to understand without some theoretical basis on which to build. In our opinion, the almost universally used phrase 'dielectric constant' is not very happily chosen as almost all, if not all, of this kind of *constant* varies with temperature. We like this book because it describes the underlying principles of such problems as the stresses in insulators, the action of vacuum tubes, and the phenomena of the kare, the spar and the corona. The object is not to help students to pass written examinations, although it will be a help in this direction as it is well written and thoroughly up to date. In describing electric heating, illustrations are given from electric toasters, stoves, apparatus for air-conditioning, etc.

We were interested to see in this book a photograph of a very up-to-date flat-iron made in America, where electric flat-irons are almost universally used. It was fitted with a device which automatically switched out the circuit when temperature rose to a definite desired value, less than 700° F., which is the highest permissible temperature if scorching is to be avoided. Beyond very elementary algebra, practically no demands are made on the mathematical knowledge of the reader.

Radio Laboratory Handbook
By M. G. Scroggie. Pp. x+384. (London: Iliffe and Sons, Ltd., n.d.) 8*s*. 6*d*. net.

THE methods and measurements used in a modern radio laboratory are described in this work, which includes details and illustrations of the available apparatus for making such measurements. The whole range of alternating current frequencies used in radio and acoustic technique is covered. Practical advice is included on the lay-out and equipment of a laboratory on scientific lines, and some useful information is provided on the construction and use of many items and components which are auxiliary to the main sets of apparatus. The book should prove very helpful to all those engaged in the use of a radio laboratory, whether from a design and development or from a research point of view. R. L. S.-R.

Fundamentals of Radio
By Prof. Frederick Emmons Terman, with the collaboration of Lieut. F. W. Macdonald. Pp. viii+458. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 21*s*.

THIS book is essentially an abridged version of the author's "Radio Engineering". It presents the basic principles of radio communication in a form suitable for an introductory course for the physicist or engineer. The treatment is confined very closely to this objective, all reference to the practical applications being reduced to the absolute minimum. The work is, however, quite up to date in so far as established principles are concerned, and the series of problems at the end of each chapter should be of great assistance to the student using the book. R. L. S.-R.

Geology

Geology and Allied Sciences
A Thesaurus and a Coordination of English and German Specific and General Terms. By Walther Huebner. Part 1: German–English. Pp. xvii+405. (New York: The Veritas Press, Inc.; London: Thomas Murby and Co., 1939.) 7.50 dollars.

THE need for a comprehensive German–English dictionary of geological terms has long been apparent to workers in this branch of science, and the work under notice is therefore welcome. The author has been engaged in its preparation for fifteen years, and certainly the work is not lacking in thoroughness. Indeed, so careful has the compiler been that no slight shade of meaning should be overlooked, that he may be accused of under-estimating the intelligence of his readers. It is not difficult to find occasional faults in his rendering of German terms, and it may be suggested that specialists would be doing a good service if they accede to the author's request to communicate corrections to him.

The price of the book is perhaps a little high for the average student, and a future edition, it may be suggested, could be shortened without loss by the omission of German terms the English equivalents of which are spelt so similarly as to make the translation obvious. Many composite words, too, have been given though their meaning is so self-explanatory as scarcely to call for inclusion in the thesaurus. Even a reader with the most elementary knowledge of both German and geology should be able to deduce for example, through looking up the terms 'basalt'

and 'gang', that 'basaltgang' means 'basalt dike'. In spite of these criticisms, there can be no doubt that this is an extremely useful contribution to geological literature.

The comparative table of the nomenclature of the Lower Palæozoic formations included at the end is incorrect, and, in any event, is unnecessary in a work of this sort.

Mathematics

101 Problems in Drawing-Board Geometry

By Prof. Frederic G. Higbee. Pp. 14+59 plates+26 blank pages. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 8*s*. 6*d*. net.

THERE is no more valuable exercise in clear thinking than the solution of a problem by a graphical method and, by presenting the problem in the form of a partial drawing accompanied by a brief description as Prof. Higbee has done, the value of the exercise is considerably enhanced. After receiving some explanation of the principle to be applied, the student is expected to complete the work in good quality draughtsmanship. He has, therefore, first to visualize the printed data in the few points and lines given, then to formulate a method of applying the principle involved and finally to work out a neat and accurate drawing-board solution. The principles had been demonstrated by the author in an earlier work "Drawing-Board Geometry" and are referred to in the present book, which consists of detachable drawing sheets ready for completion. It offers to the teacher opportunity to develop in his pupils the ability to recognize in the given points and lines the representation by projection of corners and edges of a geometrical figure or of an engineering detail.

Analyse mathématique

A l'usage des candidats au Certificat de mathématiques générales et aux Grandes Ecoles, d'après les Cours professés à l'Ecole centrale des Arts et Manufactures et à la Sorbonne. Par Paul Appell. (Cours de mathématiques générales.) Cinquième édition entièrement refondue par Prof. Georges Valiron. Tome 2: Equations différentielles, développements en séries, nombres complexes, intégrales multiples. Pp. vi+389–694. (Paris: Gauthier-Villars, 1938.) 70 francs.

THIS volume deals with differential equations (ordinary and partial), Taylor's theorem, convergence, Fourier series, complex numbers, double and triple integrals, and the theorems of Green and Stokes. The treatment is much less abstract than in the usual "Cours d'analyse"; worked examples are frequent, and the author uses geometrical arguments whenever they appear simpler than the formal mathematical treatment. There are also references to mechanics and mathematical physics. One of the concluding notes explains the principles of Amsler's and other planimeters, and of the integraph. The style is clear, the printing exceptionally good, and there are many diagrams.

Advanced Mathematics for Engineers

By Prof. H. W. Reddick and Prof. F. H. Miller. Pp. x+473. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 20*s*. net.

AMONG the various text-books which have appeared during recent years and which endeavour to bring advanced mathematical methods within the reach of the engineer this one appears to the reviewer to be of outstanding merit.

The presentation is exceptionally clear and easy to follow, since it indicates always in which direction and for what purpose an argument is being pursued, and the various steps are frequently illustrated by simple well-chosen examples. Not less will the engineering reader value the fact that the authors have shown how these methods work by applying them to a large number of problems covering a wide field of physics and engineering, and that in presenting proofs as well as applications they have considered his limited formal technique.

It is impossible to enumerate all the subjects dealt with. They range from a refresher course in differential equations and infinite series to elliptic gamma and Bessel functions, to the theory of probability, functions of a complex variable and operational calculus. A. B.

Tables of Addition and Subtraction Logarithms with Six Decimals

By Dr. B. Cohn. Second edition. Pp. viii+63. (London: Scientific Computing Service, Ltd., 1939.) 10*s*.

IF we are given the logarithms of two numbers, to find the logarithm of their sum by the aid of ordinary logarithmic tables, we must use the tables three times and perform one addition. If, however, a table of addition logarithms is available, we have only to use them once and perform one addition and one subtraction. Similarly, we use subtraction logarithms to find the logarithm of a difference. The saving of time is appreciable in spherical trigonometry, as used in navigation and astronomy. Dr. Cohn's tables are clearly printed, and include brief instructions for their use, with numerical examples.

The Nomogram

The Theory and Practical Construction of Computation Charts. By H. J. Allcock and J. Reginald Jones. Second edition. Pp. viii+224. (London: Sir Isaac Pitman and Sons, Ltd., 1938.) 10*s*. 6*d*. net.

THE nomogram is very convenient for representing the values of a function of two or more variables. In its simplest form it consists of three lines (possibly curved), two graduated to represent the values of the variables, and the third to represent those of the function. To use it we have only to place a ruler through the two points representing the variables,

and its intersection with the third curve will give the corresponding value of the function. The new edition includes circular and set-square-index nomograms. For the theory, the authors rely upon determinants and Cartesian co-ordinates.

Introduction to the Theory of Equations

By Prof. Louis Weisner. Pp. ix+188. (New York: The Macmillan Company, 1938.) 10*s.* net.

THE distinctive feature of this book is the emphasis on the concept of a field. This serves as a unifying principle connecting the various parts of an elementary course in the theory of equations, including complex numbers, the theorems of Sturm, Budan, and Descartes, elimination, symmetric functions, cubic and quartic equations, but excluding determinants, which are assumed to be known. The fundamental theorem of algebra is treated, rather unusually, by Gordan's method, reducing the theorem to a property of continuous functions which is stated without proof. The final chapter deals with ruler and compass constructions. There are many examples.

Gewöhnliche Differentialgleichungen

Von Prof. Dr. Guido Hoheisel. (Sammlung Göschen, Band 920.) Dritte neubearbeitete Auflage. Pp. 126. (Berlin: Walter de Gruyter und Co., 1938.) 1.62 gold marks.

THIS slender little volume covers much more ground than would be expected from its size. In addition to the usual elementary account of ordinary differential equations of the first and higher orders, including existence theorems, solution by series, and singular points, there is a chapter dealing with boundary value problems. This deals with Green's function, Sturm-Liouville expansions, proper values, and periodic boundary value systems. An appendix discusses the dependence of solutions of a system of differential equations upon a parameter, and upon the initial values of the variables.

Le superficie razionali

Per Fabio Conforto. Pp. xv+554. (Bologna: Nicola Zanichelli, 1939.) 80 lire.

THE present treatise is divided into two parts; the first, which occupies less than half the volume, is devoted to a systematic exposition, from the modern point of view, of the quadric, the cubic surface and the rational quartic surfaces. Here the reader will find a résumé of the classical results due to Cremona, Clebsch, Noether and others, with the various adjustments that critical considerations have necessitated. The second part deals with general theory; beginning with Noether's theorem on surfaces containing a pencil of rational curves, it proceeds to the discussion of surfaces having rational or elliptic sections, and thence to plane involutions and rational double planes. Of the latter important topic, the author gives a detailed account, the first that has ever appeared in book form. The work concludes with a chapter on Castelnuovo's theorem concerning the rationality of plane involutions.

As the author states in his preface, the work is based on lectures given by Prof. Enriques at the University of Rome; and in fact the book bears the hall marks of the collaborations (Enriques-Chisini, Enriques-Campedelli), which have provided the present generation of geometers with its standard text-books. There is the same leisurely exposition, interspersed with interesting historical information and critical notes, and the co-ordination of the material testifies to the master's skill. The work will be a valuable reference-book for every teacher of geometry.

Medicine

Vāgbhaṭa's Aṣṭāṅgahṛdayasaṃhitā

Ein altindisches Lehrbuch der Heilkunde, aus dem Sanskrit ins deutsche Übertragen mit Einleitung, Anmerkungen und Indices. Von Dr. Luise Hilgenberg und Prof. Willibald Kirfel. Lief. 5. Pp. 257–320. Lief. 6. Pp. 321–384. Lief 7. Pp. 385–448. (Leiden: E. J. Brill, Ltd., 1939.) 3.50 guilders each.

THESE three tracts form more instalments of Hilgenberg and Kirfel's scholarly translation from the Sanskrit into German of Vāgbhaṭa's treatise on medicine, the earlier parts of which have been noticed in NATURE.

The first half of Part 5 continues the discussion of the etiology and symptoms of diseases, such as boils and erysipelas, skin diseases including leprosy, abdominal swellings, which it is noted may be due to enlargement of the spleen, and rheumatism. Under rheumatism, the pain, stiffness and lameness, the involvement of the joints and of bone, are all mentioned.

The remainder of Part 5 and Parts 6 and 7 deal with treatment, mostly medicinal. The remedies prescribed are for the most part herbal ones, and have been identified by the translators; mineral remedies scarcely appear, and mixtures containing mice and other unpleasant ingredients, so commonly used in medieval medicine, are the exception. Another part should complete this work.

Modern Anæsthetic Practice

Edited by Sir Humphry Rolleston and Dr. Alan A. Moncrieff. (The Practitioner Handbooks, No. 3.) (Published on behalf of *The Practitioner*.) Pp. 231. (London: Eyre and Spottiswoode (Publishers), Ltd., 1938.) 10*s.* 6*d.* net.

THIS work consists of twelve articles, six of which had previously been published in *The Practitioner* and have since been revised by the authors, while six are new contributions. Every aspect of the subject has been discussed, including volatile anæsthetics, nitrous oxide anæsthesia in surgery, basal anæsthesia, endotracheal anæsthesia, spinal anæsthesia, anæsthesia and analgesia in midwifery, anæsthesia in the child, anæsthesia in dentistry, local anæsthesia and analgesia, the anæsthetic aspects of post-operation care, and the risks of explosion, so that the aim of the book to provide a practical manual for the general practitioner in his daily work has been admirably fulfilled.

Man against Microbe

By Prof. Joseph W. Bigger. Pp. 304+18 plates. (London: English Universities Press, Ltd., 1939.) 7s. 6d. net.

PROF. BIGGER, who is professor of bacteriology at Trinity College, Dublin, and author of a standard work on the subject, has set out to give educated readers who are not necessarily scientific investigators some idea of the nature of microbes, the methods of their study and their effects. He begins with a fascinating account of the first microbiologist, Antony van Leeuwenhoek, and then discusses the meaning and history of microbiology and the relation of microbiology to mankind, including a lucid description of the work of Koch, Pasteur, Ehrlich, Metchnikoff, Theobald Smith and Bordet among others. The text is liberally interspersed with portraits, illustrations of bacteriological equipment and microphotographs, and a glossary is appended. The work is written in an easy and familiar style, admirably suited for the class of readers for whom it is intended.

Brompton Hospital Reports

A Collection of Papers recently published from the Hospital. Vol. 7, 1938. Pp. iv+207+39 plates. (London: Brompton Hospital, 1939.) 5s.

BESIDES the annual medical report of the Hospital, this volume contains twenty articles, of which all but two, describing a method of inducing artificially selected collapse in pneumothorax therapy and an exhaustive account of the cauterization of pleuropulmonary lesions, have been published elsewhere. The other articles deal with various aspects of pulmonary tuberculosis, pneumonia and bronchiectasis, artificial pneumothorax, obstruction of the trachea, thoracoscopy and cauterization of adhesives, radiology and the surgery of inflammatory lesions of the lungs, cardiac emergencies and the prevention of minor ailments. The indexes of authors and subjects for vols. 1–7 are included.

Medicine in Modern Society

By David Riesman. Pp. vii+226. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1938.) 11s. 6d. net.

IN this work, which is based on his Vanuxem lectures delivered at Princeton University, Dr David Riesman, formerly professor of clinical medicine and now occupying the chair of the history of medicine in the University of Pennsylvania, has given the layman a clear and comprehensive account of the progress of medicine in the nineteenth and twentieth centuries and of the various problems which have arisen during that period. The subjects discussed include cancer, medical education, the prevalence of neurosis, superstitions and cults, with special reference to homœopathy, osteopathy and chiropractic, medicine as a career, the family doctor, medical ethics and preventive medicine.

Recent Advances in Forensic Medicine

By Dr. Sydney Smith and Dr. John Glaister. Second edition. Pp. viii+264+16 plates. (London: J. and A. Churchill, Ltd., 1939.) 15s.

THE principal subjects discussed in this well-known work, which should prove indispensable alike to medical jurists and barristers, are the diagnosis of injuries from projectiles, the identification of firearms, the examination of powders and the products of their production, the medico-legal application of the precipitin and other tests based on the action of precipitins and the individuality of the blood. The chief additions to the new edition, which contains seventy more pages and nineteen more figures than the last, are the incorporation of recent work on blood grouping, a chapter on the cuticular scales of hair by Prof. Alan R. Moritz of Harvard University, enlargement of the chapter on spectroscopy in medico-legal work, important additions to the chapter on alcohol in the blood, including an account of Widmark's method, and a note on larval infestation and putrefaction by Dr. A. G. Mearns.

Miscellany

If War Comes (an Essay on India's Military Problems)

By B. P. Adarkar. Pp. 41+xxxii+306+19 plates. (Allahabad: The Indian Press, Ltd., 1939.) 2.8 rupees.

THE central theme of this essay on problems of defence in India from the Indian point of view is that India's only hope of safety lies in full partnership and co-operation with Great Britain. The author argues that Indian and British interests are essentially the same in a world war, and that for India to remain outside, even if allowed, might merely result in her falling under a fresh foreign dominion. If, however, India needs Great Britain's help in defence he urges that Great Britain needs the help which India's man-power and natural resources could contribute. The effect of the rapidly changed conditions of modern warfare upon the individual problems of the defence of India is discussed, and Prof. Adarkar in a series of chapters urges the planning of Indian defence to ensure the most effective co-operation between Indian and non-Indian on terms of mutual respect, the efficient utilization of Indian resources and the stimulation of industry, trade and transport in India on lines designed to render her less vulnerable and more self-supporting or independent in the event of hostilities.

If his book is intended to bring home to his countrymen the reality of their danger it equally makes an appeal to Great Britain for yet more generous treatment the sincerity of which cannot be doubted. The community of interest between Great Britain and India offers an opportunity of developing yet further the spirit of national service, good will and co-operation which may overcome the difficulties in the way of full self-government whether from Hindu-Moslem jealousies, the problem of the Native States or embedded prejudices of the Services.

Gems and Gem Materials

By Prof. Edward Henry Kraus and Prof. Chester Baker Slawson. Third edition. Pp. xiii+287+4 plates. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 21*s*.

"KRAUS and Holden" has now become "Kraus and Slawson", as Prof. Kraus has been assisted in the preparation of this third edition of the book by Dr. Slawson, Dr. Holden having unfortunately died before the publication of even the first (1925) edition.

The features which have formerly made the book so popular have been still further strengthened, and there are twenty-seven additional pages and nineteen more illustrations in the text. The most immediately obvious improvement is the incorporation of four fine coloured plates of gem-stones, which originally appeared in Eppler's "Edelsteine und Schmucksteine". The chapters on cutting and polishing and on synthetic stones have been expanded and are now exceptionally good, and a short but useful chapter has been added on the metals used in jewellery.

Most of the small inaccuracies which were found in previous editions have now been corrected, but some still remain; notably in the diagram of absorption spectra and in the density figures given for synthetic and natural spinels. In the figures given throughout the book for specific gravity and refractive index the authors favour the broad values of the mineralogist rather than the more exact values which are often of diagnostic importance to the gemmologist.

Thanks to the clarity of the writing, the wide range covered by the book, and its many illustrations, "Gems and Gem Materials" is one of the most attractive texts on the subject that has yet appeared. It is a pity that so liberal a use of illustrations must inevitably entail a price which the needy jeweller's assistant will find it difficult to afford. B. W. A.

Evidence of Identity

By Kenneth Richmond. (Psychical Experiences Series.) Pp. viii+112. (London: G. Bell and Sons, Ltd., 1939.) 3*s*. 6*d*. net.

THIS is another of the short text-books on psychical research which have been recently issued to supply a demand for material of better quality than that usually provided by the majority of writers on spiritualism. The examples selected are mainly based upon cases collected and examined by the Society for Psychical Research, and thus their evidential value is somewhat enhanced.

In the present volume, Mr. Richmond is concerned with the question of identity, not so much from the point of view of the survival of personality after death as from that of the problem of the means by which any kind of identity can be established when considered in relation to mediumistic communications. In the course of his discussion, the author makes no attempt to minimize the difficulties involved; and his treatment will go some way to curb the enthusiasm of the uncritical believer and the seeker after miracles.

Apart from the fact that Mr. Richmond seems to lay a somewhat undue stress upon the rather dubious evidence supplied by the well-known American "Livre des Revenants", this little book is a good example of the work undertaken by the more sober among psychical researchers, and the author is to be congratulated upon the general level of criticism that he maintains throughout. A short glossary of terms most commonly used is appended, but there is no index.

Guide to Business Management Books

By G. E. Milward. Seventh edition. Pp. xiv+124. (London: Management Library, 1939.) 5*s*.

THE seventh edition of the Guide to Business Management Books, 1939, has been issued in cloth binding. It includes all notable books published during the six years up to and including November 1938. The Guide is arranged on the same lines as previous editions and the more outstanding books of 1938 are listed separately in the preface. The courses of reading printed in the Guide have again been expanded and are particularly adapted for staff training, although the biographical section might well be developed further, and include special studies which illustrate merits or defects of management in practice. A serious defect which should be rectified in subsequent editions is the absence of any dates of the editions of the works included.

The Subject Index to Periodicals, 1938

Pp. xxix+544. (London: The Library Association, 1939.) 70*s*.

THIS index, issued by the Library Association, is arranged under subject headings in alphabetical order, chosen from the alphabetical subject headings in the Library of Congress, U.S.A., with modifications and additions to suit British practice. With some important exceptions, periodicals covered by the *Agricultural Index*, *Engineering Abstracts*, *Engineering Index*, *Index Medicus*, *Journal of the Society of Dyers and Colourists*, *Photographic Abstracts*, *Science Abstracts*, *Journal of the Textile Institute*, *Royal Meteorological Society Bibliography* and the *Revue de Géologie, Mineralogie et Crystallographie* are not included. The location list first published in the 1937 volume has been retained and gives valuable information regarding the periodical holdings of more than a hundred and seventy of the national, municipal and institutional libraries in the United Kingdom. The locations are tabulated in seven columns, each covering a large area of the country, but the inclusion of a library in the location list implies no guarantee that it is prepared to issue periodicals to outside borrowers. Brief annotations are given where the titles do not sufficiently indicate the subjects of articles, but verse and fiction are not included. Under each heading, articles are arranged alphabetically by authors' names.

Iceland Papers, Vol. 1

Scientific Results of Cambridge Expeditions to Iceland, 1932–38. Pp. vii+17 papers. (London: Oxford University Press, 1939.) 21*s*. net.

THERE is no better training for young men than to send them away from their families and teachers, giving them jobs that they feel to be incursions into the unknown. Such was the idea of the geographers of Oxford and Cambridge, but they found themselves restricted by university terms to the summers. Work in North Africa and to the south could be carried on at any season, but only in summer could the north be attacked. In consequence, we see year by year parties from Oxford going to Spitzbergen and from Cambridge to Iceland, while both universities, often using more experienced seniors, visit Greenland.

Geography includes nearly all science, and nothing comes amiss. In no section can much be accomplished in one northern season, and the torch is passed on from one party to another and so knowledge accumulates. In a series of separata, bound up together, we have the results of twelve Iceland visits from 1932 to 1938, usually two or three men together. They comprise five devoted to physical geography, six to birds, four oddments concerning spiders, worms, Collembola and freshwater algæ, and two stronger accounts of the Central Desert and of Grimsey Islet, necessarily on botanical lines.

We wish success to these ventures, and we approve of Iceland, for great profit may be foreseen in similar summer expeditions for several decades.

L'Année psychologique

Fondateurs: Henry Beaunis et Alfred Binet. Publiée par Prof. Henri Piéron. (Bibliothèque de philosophie contemporaine.) Année 37 (1936). Tome 1. Pp. xxiii +448. Tome 2. Pp. 449–844. (Paris: Félix Alcan, 1937.) 150 francs.

THIS yearly publication is always eagerly expected by psychologists, for it gives an accurate account of the research made in the various fields of psychology during the year. Reviews of books and of special articles are listed according to their subject; and the principal points in them are clearly explained. A series of specialized contributions add to the interest of this survey. In this issue might be mentioned those of Geblewicz and Shen (Rôle du temps dans la perception de la profondeur), of H. Piéron (Types d'intelligence), and of Fauville, Dewyn and Ellis (Aptitudes motrices et aptitudes perceptives).

T. G.

Urmass und Schöpfung

Neuentdeckte Gesetzlichkeiten. Von Ernst P. v. Schoen-Wildenegg. Pp. viii+235. (Berlin: G. Schoenfeld's Verlagsbuchhandlung, 1938.)

THE author investigates the origin of our system of numbers on the basis of biological facts. He attempts to prove the dominating existence of the geometrical progression in living beings as well as in celestial phenomena. Investigating and confirming some well-known facts, such as the distribution of the planets, he derives a number of empirical relations between the bodies of the solar system. Apart from this section of the book, which bears quite a personal note, the book as a whole is quite stimulating to read for all those interested in the physical and biological foundation of our past and present concept of measurement and number.

Animal and Bird Painting

The Outlook and Technique of the Artist. By Charles Simpson. Pp. viii+136+68 plates. (London: B. T. Batsford, Ltd., 1939.) 10*s*. 6*d*. net.

AN eminently readable book. The domain of animal painting has been little invaded by the 'wild men' of modern art, who would possibly be annoyed by the author's insistence on sincere observation, not only of animal structure and movement, but also of the landscape environment. Different classes of animals are treated in some detail, with short accounts of their origin and varieties. The student of animal painting will find help in the author's references to the particular snags and difficulties in the matter, and in his very practical advice on the method of catching and memorizing a special aspect of a moving subject. Considerable attention is given to the correct sequence of movements in walking and running animals. The influence of light in eliminating detail must not prevent close representation of essential form and solidity. Many paintings of animals should be called studies merely, in that the extreme details of anatomy are allowed to obscure the values in the picture as a whole.

The book is well and copiously illustrated by black-and-white reproductions of the works of old and modern masters of animal painting.

Physics

Physics for Technical Students

Sound, Electricity and Magnetism, Light. By Prof. W. B. Anderson. Third edition. Pp. x+361–796. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 15*s*.

THE stumbling block for many advanced technical students is inadequacy of training in fundamental physics. Physics is undoubtedly a subject in which, to the physicist, there can be no compromise; for the man who is to become one of a number of kinds of engineer and not a physicist, there is much to be gained by selecting those aspects of physics which are likely to be of greater use to him than other aspects. What these aspects are experience must tell; technology is daily becoming more scientific and an adequate syllabus must be continuously brought up to date.

The present text-book is along the right lines, but may not be entirely suitable for English engineering

students. One thing that might have been done to improve its detail would have been the collaboration of a scientifically trained engineer, who would have introduced a greater conformity with the language of technology, so that the ideas may be more easily grasped by a technical student. Nevertheless, the author's work is very suggestive in forming fundamental treatments of physical phenomena for students specializing in applied science rather than in science itself. L. E. C. H.

Motion Picture Sound Engineering

A Series of Lectures presented to the Classes enrolled in the Courses in Sound Engineering given by the Research Council of the Academy of Motion Picture Arts and Sciences, Hollywood, California. Pp. xviii+547. (London: Chapman and Hall, Ltd., 1938.) 30*s*. net.

THIS text is the successor to "Recording Sound for Motion Pictures", compiled by some twenty authors and edited by Lester Cowan. In the distant days of 1931, the pioneer technicians of a new industry, that of adding sound to scene, had a great deal of what was new to say; their effort in print was by no means perfect, but it gave the impression of vitality and freshness. In the present publication we do not get a complete view either of the industry or of studio technique. The latter has changed extensively in the last decade, but we cannot judge what in the older book is now obsolete and what is now of primary importance. That is not to say that the first 175 pages are not valuable. They deal lucidly with technical solutions of many difficult practical problems which confront the recording engineer.

In a highly competitive industry, research has in recent years been on a co-operative basis, directed by the Research Council of the Academy of Motion Picture Arts and Sciences, which, through committees of experts, has sorted out the problems and used the best resources of the industry; the description of the results obtained gives an air of finality to the attainable criteria prevailing at the present time and that there is not much more to be done until there is another upheaval in the industry, such as the adoption of stereophony.

From the general acoustic point of view, great importance must be attached to the specification and realization of a standard of radiated sound reproduction, against which commercial systems can be compared and assessed in respect to their defects. The radiating system comprises two parts, one a cellular horn covering the range 300 c.p.s., to 10,000 c.p.s., driven by a phase-adjusted duralumin diaphragm, the other a set of large cone diaphragms operating through a horn terminated with a large baffle. The response results in a fluctuation within two decibels over the range 50 to 8,000 c.p.s., over a horizontal angle of nearly 110 degrees and a vertical angle of 60 degrees, with a maximum electro-acoustic efficiency approaching 50 per cent. The amplitude distortion and flutter specified in the reproducing machine and radiator set new standards for sound reproduction. The new types of push-pull recording on film, the control of the noise-level, microphones, and the new types of photo-electric cell which are required to reproduce the push-pull sound-tracks are very well treated. Film processing is rather less well done than before.

The remaining three hundred pages do not carry the subject much further, because attention is diverted to details of electrical circuits, such as transformers and filters and elementary circuit theory, which appear to have been included solely because they happened to fall into a series of lectures to film technicians as a part of their education. The only part which is not done better elsewhere by specialists is the section on properly designed equalizers; the dividing networks are new, and have been forced into reproducing circuits by the necessity of operating loudspeaking receivers in series or parallel without overloading them with currents of frequencies for which they are not intended to have appreciable response. One concludes that there is good material in the present text, but it has been made expensive by the inclusion of much extraneous elementary matter. L. E. C. HUGHES.

Textbook of Heat

By Dr. R. Wallace Stewart and Dr. John Satterly. Revised by C. T. Archer. Second edition. Pp. vii+410. (London: University Tutorial Press, Ltd., 1939.) 7*s*. 6*d*.

THIS is a book on the theory of heat written for students of the standard of the intermediate university examinations. It appears to fulfil its function admirably, and should afford an excellent introduction to the more advanced works on thermodynamics. There is no great originality of treatment, but all the usual branches of heat are dealt with in an adequate manner. The type used is clear, and the text is well illustrated by more than two hundred bold diagrams. The large selection of questions taken from recent examination papers of the University of London should prove useful to students.

Ions, Electrons and Ionizing Radiations

By Prof. J. A. Crowther. Seventh edition. Pp. xii+348+7 plates. (London: Edward Arnold and Co., 1938.) 12*s*. 6*d*. net.

THE seventh edition of this well-known book is to be welcomed, for in it the author has been enabled to give an account of some of the more recent developments of the rapidly changing subject of atomic physics. Experiments on the structure and disintegration of the nucleus are described, including those made by means of the cyclotron, and there is also a discussion of the production of the artificial radio-elements such as radio-sodium and radio-phosphorus. The section on cosmic radiation has also been rewritten and enlarged. Prof. Crowther possesses the gift of lucid explanation, and it suffices to say that the additions now made reach the same high standard as the remainder of the work.

30: Mars on September 23. Mars, Jupiter and Saturn are the triad of evening stars. Mars, post-opposition, decreases from mag. — 1·8 to mag. — 1·1. Jupiter is in opposition on September 27 and reaches its greatest brightness (mag. — 2·5). Close groupings of Jupiter's four inner satellites are seen at 0h. 15m. on September 5 (satellite II in eclipse), 6, 13, 23, and 30. The ring system of Saturn has now reached its most open phase for this year. The variable star, Algol, is well placed for observation all night. The Pleiades rise in the late evenings "like a swarm of fireflies tangled in a silver braid". The chief interest, however, on clear moonless nights in autumn is the region of the Milky Way. Apart from its remarkable structure—star clouds, dark rifts and "coal sacks", and gaseous nebulæ, the galactic plane is also the preferential region for classes of stars of peculiar interest, novæ Cepheid variables and O-type stars. In the direction of the rich fields of Sagittarius lies the centre of our stellar system more than 30,000 light years away and obscured from sight by absorbing tracts of cosmic dust and of gas. Tracing a path slightly inclined to the Milky Way is a belt of bright stars that includes the brightest stars in Orion, Taurus, Cassiopeia, Cygnus and Lyra. These stars and others of the brighter *B*-type and *A*-type are representatives of a relatively small local cluster that is some 2,000 light years in diameter and contains the solar system. The average star density of the Milky Way fields is about 40,000 stars per square degree; towards the poles of the galaxy the density falls to about 1,200 stars. The 100-inch telescope at the Mount Wilson Observatory has recorded with exposures of 200 minutes on fields at the north galactic pole as many recognizable nebulæ per unit area of the sky as stars! These remote stellar systems are exemplified by the great Andromeda Nebula visible to the unaided eye as a hazy patch near the star ν Andromedæ.

Announcements

AT the first meeting of the Council of the newly formed Gas Research Board of the gas industry, it was announced that the first president of the Board would be Sir David Milne-Watson. The appointment of the secretary of the Institution of Gas Engineers as the first secretary of the Board was confirmed.

THE Medical Research Council has appointed Dr. Donald Hunter, physician to the London Hospital, and Mr. Harold E. Clay, national secretary of the Passenger Services Group, Transport and General Workers' Union, to be members of the Industrial Health Research Board, in succession to Prof. J. A. Nixon and Mr. R. Coppock.

THE College of Physicians of Philadelphia has awarded the Alvarenga Prize to Dr. Harry Goldblatt, professor of experimental pathology and associate director of the Institute of Pathology, Western Reserve University, Cleveland, Ohio, for his outstanding contributions to the pathogenesis of hypertension.

A REPRESENTATIVE body of members of the Institution of Civil Engineers is sailing from Liverpool on August 26 to participate, at the invitation of the American Society of Civil Engineers, in a British-American Engineering Congress opening in New York on September 4, and to visit the World's Fair and various places of engineering interest. The party numbers about a hundred, coming not only from Great Britain but also from India, Australia, South Africa, Nigeria, Iran and Palestine, under the leadership of Mr. W. J. E. Binnie, president of the Institution. It is thirty-five years ago since an official visit to America was made by members of the Institution.

THE fifty-second annual conference of the Sanitary Inspectors' Association will be held at Bournemouth on September 4–9 under the presidency of Mr. J. C. Dawes. Further information can be obtained from the secretary, 18 Grosvenor Place, London, S.W.1.

THE American Association of Biophysics and Cosmobiology is organizing an international congress of biophysics, biocosmics and biocracy to be held in New York on September 11–17 with Prof. D. Arsonval, Branly, Langevin and Tchijeskvy as honorary presidents. Further information can be obtained from the general secretary, 39 rue Scheffer, Paris 16e.

THE seventh Congress of the French Society of Phoniatrics will be held on October 17 at the Paris Faculty of Medicine when Dr. Pichon and Mme. Borel-Maisonny will read a paper on aphasia and psychogenic disorders of speech. Further information can be obtained from the general secretary, Dr. Tarneaud, 27 avenue de la Grande-armée, Paris 16e.

A EUROPEAN Conference on Rural Life will be held under the auspices of the League of Nations in Geneva during October 16–31. The Conference will be devoted to the well-being and solidarity of European rural life. Preliminary information, national monographs and technical documentation are being published in this connexion by Messrs. Allen and Unwin, 40 Museum Street, London, W.C.1. Further information can be obtained from the Secretary, League of Nations, 16 Northumberland Avenue, London, W.C.2.

A QUARTERLY review of philosophical books and periodicals in the form of brief excerpts and synopses will make its appearance in the early part of October of this year under the title *Philosophic Abstracts*. The intention is not only to present English-speaking philosophy departments with a bibliography of essential philosophical literature, but also to give them an opportunity of keeping abreast with the principal philosophical theories as presented by their respective authors. The editorial offices are at 884 Riverside Drive, New York, N.Y.

DR. HERBERT H. BROWN, one of the signatories of the letter entitled "Sponge Mortality in the Bahamas" which appeared in NATURE of May 13, p. 807, has written pointing out that his name is incorrectly printed as "Hubert H. Brown" at the end of the letter.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 384.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Role of Dietary Choline in Neurohumour Production

THE lipotropic action of choline[1] and the role of choline in the formation of acetylcholine have not hitherto been studied in the same experimental animals. It seems reasonable to suppose, however, that, in addition to the production of the familiar fatty liver, lack of dietary choline might result in deficient formation of the neurohumour, acetylcholine. The findings in preliminary experiments[2] suggested that this is indeed the case.

The present experiments were designed to test the hypothesis that a diet poor in choline results in a low level of vagus activity and that this in turn is due to deficient formation of acetylcholine at the nerve endings. Rats were used as experimental animals, and were kept on the various diets for at least nine weeks. Vagus activity was evaluated by observing the slowing of the heart brought about by electrical stimulation (twelve impulses per second at maximal strength) of the distal cut end of the left vagus nerve. The resting heart-rate in rats (170–250 gm.) under urethane anæsthesia on a normal diet is from 300 to 500 beats per minute. The heart rate of animals on a low-choline diet or of those receiving the same ration with added choline fell within these limits. In one series of animals vagus stimulation reduced the heart-rate to approximately 30 per cent of the normal value in rats on a normal diet, to 45 per cent in rats on a low-choline-plus-choline diet and to 75 per cent in the animals on a low-choline diet. In other series many of the rats on the low-choline diet showed a normal vagus effect but others, as seen consistently in the small series cited above, showed very little change in heart rate on vagus stimulation. The most suggestive finding of this investigation is that, in animals on a low-choline diet showing little effect of vagus stimulation, the intravenous administration of choline (0·5 c.c. of 2 per cent choline chloride) increased this effect. This phenomenon was never seen in rats on a normal or low-choline-plus-choline diet.

We conclude that deficient vagus function may be linked with a low intake of dietary choline and this may, in part at least, be rectified by injected choline. It is therefore reasonable to suggest that choline deficiency may result in deficient formation of acetylcholine at the nerve endings. This and other possibilities are to be tested further in subsequent experiments in which it is hoped that dietary conditions producing an even more drastic deficiency of choline may be utilized.

D. Y. SOLANDT.
Departments of Physiology and Physiological Hygiene, University, Toronto. C. H. BEST.
July 29.

[1] Best, C. H., and Ridout, J. H., *Ann. Rev. Biochem.*, **8**, 349 (1939).
[2] Solandt, D. Y., *Canad. Chem. and Process Indus.*, **23**, 280 (1939).

Effect of Lipoid Solvents on Vaccinia Virus

THE elementary bodies of the dermal strain of vaccinia virus can be obtained readily from the skin of the infected rabbit's back in suspensions showing a high degree of physical and immunological homogeneity; the virus contains protein, carbohydrate and ether-soluble lipoid material[1]. We find that, after drying and extraction with benzene or ether, the dry density is increased from 1·26 to 1·31 and it is possible to redisperse the virus residue by mechanical grinding in buffer solution. The appearance by dark-ground examination and the sedimentation constant of the resuspended virus particles are unchanged, and the boundary inhomogeneity is slightly reduced. The infectivity of the virus is unaltered by this treatment and it is therefore probable that the lipoid material extracted with ether (consisting largely of cholesterol and acetone-soluble fat) is derived from the host and adsorbed on the virus.

The ether-extracted virus still contains 9 per cent of lipoid material, containing some 2 per cent phosphorus, which can be extracted only with alcohol or alcohol-ether mixtures. The virus residue after treatment with alcohol has almost entirely lost its infectivity, but it is impossible to say whether this is due to the removal of the lipoid material or to the concomitant effect of alcohol on the virus protein. The virus residue now has a density of 1·36 and suspensions give completely inhomogeneous boundaries in the centrifuge. It contains 15·5 per cent nitrogen and 0·7 per cent phosphorus. Colorimetric carbohydrate estimations (total carbohydrate[2], orcinol-HCl pentose test and Feulgen reaction) indicate the presence of approximately 3 per cent thymonucleic acid and 4 per cent carbohydrate; tests for glucosamine after acid-hydrolysis were positive.

Washing the virus repeatedly with water or dilute buffer, which is known to result in the liberation of specifically precipitable protein[3], was found to remove nitrogen, phosphorus and carbohydrate but no nucleic acid. If the ether-extracted virus is treated with 1 per cent sodium carbonate at 20°, practically all the nucleic acid and 40 per cent of the carbohydrate pass into solution in 1–2 hours. This effect is followed by a gradual disintegration of the residue into particles of widely different sizes, some only slightly smaller than the original.

Though in its chemical and immunological complexity vaccinia virus approaches more nearly to the bacteria than to the plant viruses, there appears to us to be little evidence that the substance of the virus is held within a cell membrane. The evidence which has been given[4] of osmotic swelling (derived indirectly from measurements of sedimentation rates in media of different density) is open to serious objections; and such swelling can be observed in protein gels. There is no evidence of selective ion permeability

and the resistance of the virus particle to attempts at mechanical disruption, to drying and to the action of ether militates against the idea of a fluid cytoplasm constrained within a membrane. The piecemeal disintegration of the virus particle in sodium carbonate solution suggests to us that the virus has a gel-like ability to preserve its form, in which the nucleic acid and perhaps also the bound lipoid present play an essential part. The analogy with a protein gel is not altogether satisfactory however since, although there is evidence[5] that much water is associated with the virus, the mechanical properties and the intense light scattering suggest that this water belongs mainly to an ion atmosphere and not to the central particle.

This work has been carried out in collaboration with Dr. C. R. Amies and Dr. G. H. Eagles; a full report will be made later.

A. S. McFarlane.
M. G. Macfarlane.

Lister Institute,
London, S.W.1.
July 26.

[1] Hughes, T. P., Parker, R. F., and Rivers, T. M., *J. Exp. Med.*, **62**, 349 (1935).
[2] Pirie, N. W., *Brit. J. Exp. Path.*, **17**, 269 (1936).
[3] Craigie, J., and Wishart, F. O., *J. Exp. Med.*, **64**, 803 (1936).
[4] Smadel, J. E., Pickels, E. G., and Shedlovski, T., *J. Exp. Med.*, **68**, 607 (1938).
[5] McFarlane, A. S., *Proc. Roy. Soc.*, B, **125**, 301 (1938).

Effect of Ultrasonic Vibration on Vaccinia Virus

Earlier experiments by Hopwood and Gordon[1] showed that calf lymph vaccine virus retained its infectivity after subjection to ultrasonic vibrations (*c.* 500 kilocycles/sec.) and even appeared to have an increased infective titre. The increase was attributed to disengagement of virus from particles of inert material in the crude lymph. Rivers *et al.*[2] found that sonic vibrations of considerably lower frequency (8,900 per second) applied for 15 minutes to purified suspensions of vaccinial elementary bodies resulted in a detectable reduction in their infectivity, and noted that adventitious substances, particularly protein, protected the virus from inactivation.

Using washed vaccinial elementary bodies of a rabbit dermal strain, in every way comparable to Rivers' preparations, we have dried the virus from the frozen state, extracted the 'adventitious' lipoid[3] with benzene, and redispersed the elementary bodies completely with ultrasonic vibration, without loss of infectivity.

The washed, dried and benzene-extracted virus was irradiated at 550 kilocycles/sec. in a thin-walled glass tube containing dilute phosphate buffer. Three successive exposures lasting 1½ minutes were given, and, by cooling the tube in ice between the exposures, the temperature was kept below 20° C. throughout. The milky suspension was centrifuged for 15 minutes at 3,000 rev. per minute, whereby about a third of the virus was deposited. The deposit was again irradiated and centrifuged; after two or three repetitions of this treatment, more than 95 per cent of the original dry virus was found to have been dispersed. Intracutaneous inoculations in the rabbit showed no significant difference between the titres of the original undried virus and that of the virus dried, benzene-extracted, and resuspended, either by ultrasonic vibration or by grinding[3]. The microscopic appearance of stained specimens, and of unstained specimens by dark-ground illumination, the sedimentation rate, and boundary homogeneity, were also unaffected by the ultrasonic treatment.

F. L. Hopwood.
M. H. Salaman.

St. Bartholomew's Hospital,
London, E.C.4.

A. S. McFarlane.

Lister Institute,
London, S.W.1.
July 29.

[1] Hopwood, F. L., *J. Sci. Inst.*, **6**, No. 2, 39 (1929).
[2] Rivers, T. M., Smadel, T. F., and Chambers, L. A., *J. Exp. Med.* **65**, 67 (1937).
[3] McFarlane, A. S., and Macfarlane, M.G., see preceding letter.

A Benzpyrene Tumour Strain in Hamsters with Tendency to Metastasis Formation

Experiments on the hamster with carcinogenic substances have so far been described only in a short communication by Gye and Foulds[1]. Our experiments were made with the view of demonstrating whether the tumours caused in the hamster by carcinogenic substances show any peculiarities with regard to formation and course. 40 hamsters (*Cricetus aureus*) were given subcutaneous injections of 0·25 c.c. of a 1 per cent solution of benzpyrene Meurice. 93 per cent of the animals developed tumours after a latent period of three months on the average. Histologically they were polymorph cell sarcomata.

Whereas we never observed metastases in rats with primary or transplanted benzpyrene tumours, we found these in a hamster tumour strain which we have been passaging since February 1938. The special features of this metastasis formation are: (1) the extraordinarily large number of animals which developed metastases; (2) the preference of metastases for lymph glands; (3) their spread through the greater part of the body. Of 54 hamsters sectioned, 39 (72 per cent) showed metastases. All the animals had metastases in the lymph glands. One animal had in addition a metastasis in one kidney. The process involved the axillary, groin and mediastinal glands and a chain of glands in front of the lumbar spine down to the pelvis. Mostly several glands are affected, but in many cases all the glands in the above-mentioned regions are involved. The axillary region and mediastinum showed the largest tumours. We are here, therefore, dealing with a dissemination resembling a systemic disease.

Splenectomy or complete irradiation of the whole body with X-rays does not noticeably increase the percentage of animals with metastases. In some cases it is possible to transmit tumours by the subcutaneous injection of blood from hamsters with metastases.

The spread of the tumours in our hamsters resembles the changes in the lymph glands of tumour-bearing mice described by Parsons[2]. This worker assumes that because transmission is effected through filtered cell-free material, dissemination is caused by a filterable agent. We have not yet completed transmission experiments with filtrates. But we have deprived gland material of cells capable of multiplication by means of X-rays by the method employed by Doljanski and Halberstaedter[3] in Rous sarcoma. Attempts at transmission with such material have so far been negative.

While it is not usual to find metastases in rats with primary benzpyrene tumours, Oberling and M. and P. Guérin[4] have succeeded in obtaining them by injecting very large quantities of benzpyrene. Injection of 75 mgm. of benzpyrene will cause metastases in 50 per cent of rats. Oberling and Guérin consider that this is due either to the fact that large doses of benzpyrene lower the resistance of the organs, or that the tumour cells produced by large doses are more aggressive and proliferative.

In our cases, the animals showing metastases did not come into contact with benzpyrene. It must be assumed that both the tendency to metastasis formation and the organ affinity in our tumour strain is based upon a peculiar property of the tumour cells themselves.

L. HALBERSTAEDTER.

Department of Radiobiology,
Cancer Laboratories,
The Hebrew University,
Jerusalem.

June 30.

[1] *Amer. J. Canc.*, **35**, 108 (1939).
[2] *J. Path. Bact.*, **47**, 501 (1938).
[3] NATURE, **143**, 228 (1939).
[4] *Bull. Assoc. franç. Etude Canc.*, **28**, 198 (1939).

Lethal Action of Alpha-Rays on Sea-Urchin Eggs

WHEN unfertilized eggs of sea-urchin, *Pseudocentrotus depressus* (A. Agassiz), are inseminated immediately after the irradiation with gamma- or beta-rays of radium, the time of their first cleavage is prolonged roughly in proportion to doses[1]. This phenomenon has the same tendency to that already reported by Henshaw[2] and others, who used roentgen rays and ultra-violet light. Recently, we have studied the effect of alpha-ray irradiation and obtained quite different results.

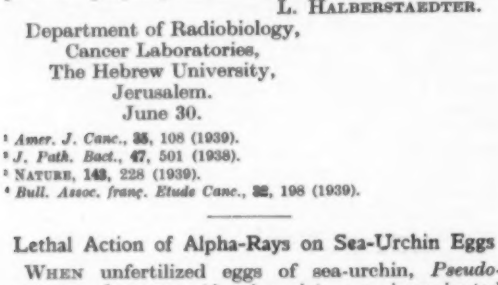


Fig. 1.

CURVES SHOWING THE PERCENTAGE INCREASE OF EGGS IN TWO-CELL STAGE AFTER INSEMINATION.

C: CONTROL; β: IRRADIATED WITH BETA-RAYS (30,000 r IN ONE HOUR); α_1 AND α_2: IRRADIATED WITH ALPHA-RAYS (48 MC.-SEC. IN 10 SECONDS AND 145 MC.-SEC. IN 1 MINUTE).

The following experiment was made on the eggs of sea-urchin, *Strongylocentrotus purcherrimus* (A. Agassiz). Eggs were carefully placed in a single layer in a small dish, 7 mm. in diameter with a thin bottom of collodion film, less than 1 μ in thickness. Under the dish a piece of glass with radium C′ was placed at the distance of 5 mm. As the range of alpha-rays of radium C′ in water is 60 μ, taking into consideration the absorption of the air and the specific gravity of eggs, the alpha-rays are estimated to penetrate into the eggs as far as 51 μ. The diameter of the eggs is about 90 μ. In every experiment the intensity of radium C′ activity was measured by electrometer and the dose is expressed by millicurie-second, considering the decay of radium C′.

Fig. 1 indicates the increase of the percentage of eggs in two-cell stage produced by first cleavage with the lapse of time after insemination. Curve C shows control, curve β a case of beta-ray irradiation, and curve α_1 and α_2 two cases of alpha-ray irradiation. The eggs irradiated by beta-rays (curve β) take some time to begin cleavage and their cleavage goes on slowly, but the tendency resembles control. Small doses of alpha-rays produce no effect on the cleavage time. Even after larger doses of alpha-rays (curve α_1) the beginning time of the cleavage is almost the same as in control. (A very little prolongation shown is considered as the effects of beta-rays accompanied by alpha-rays.) Moreover, in this case the cleavage proceeds very fast at the beginning, but seems to stop when a certain percentage of cleavage is reached, while after several hours it goes on very slowly again. Thus in the case of alpha-ray irradiation, some eggs take the ordinary course of cleavage, while in others the cleavage is delayed. With the increasing doses of alpha-rays, fewer cases of the ordinary cleavage are observed (curve α_2), and some eggs stop cleavage absolutely. Even the eggs producing fertilization membrane by insemination with normal sperm stop cleavage, and from about one hour after the irradiation they gradually disintegrate, as is shown in Fig. 2. This disintegration phenomenon can be seen in the same way in unfertilized eggs. This is death caused directly by alpha-rays.

Fig. 2.

MICROSCOPIC APPEARANCE OF NON-IRRADIATED (A) AND IRRADIATED EGGS IN EARLY (B) AND COMPLETE (C) DISINTEGRATION.

We are indebted to Prof. M. Nagayo, Dr. H. Yamakawa and Dr. W. Nakahara for their kind advice and encouragement.

MITUO MIWA.
HISAO YAMASHITA.
KAZUO MORI.

Radiological and Pathological
Divisions of the Japanese Foundation
for Cancer Research, Tokyo.

May 24.

[1] Miwa, Yamashita and Mori, *Gann*, **33**, 1 (1939).
[2] Henshaw, P. S., *Amer. J. Roent.*, **27**, 890 (1932).

Amino-Acids and Rooting of Cuttings

THE work of Went and co-workers and that of Zimmerman and his associates has amply demonstrated the value of the so-called 'root-forming' hormones. Went, Bonner and Warner[1] have shown that in certain cases vitamin B_1 treatment of hormone-treated cuttings has resulted in a great increase in the rapidity of rooting and in the number of roots produced. I have confirmed this finding in the case of one species, namely, *Camellia*, used by these workers, but it is apparent that the treatment with vitamin B_1 (aneurin) must be given at the appropriate time after hormone treatment. This period after hormone treatment is difficult to determine. In some instances response has been rapid and at other times no response to vitamin B_1 has been obtained, but the same cuttings may respond to later treatment.

White[2] has shown that certain amino-acids are essential for the growth of excised tomato roots. The amino-acids found necessary were: glutamic acid, lysine, histidine, phenylalanine, leucine, isoleucine, valine, serine and proline. Went and co-workers, referring to "essential amino-acids" in the paper[1] referred to above, predicted that "cuttings may be found in which root development is limited by these substances".

In the course of my experiments, a mixture of the above-mentioned amino-acids was used to treat cuttings which had just been treated with α-naphthalene acetic acid at a concentration of 1 part in 20,000 of water. The cuttings used were *Rhododendron Maddeni* var. *Jenkinsii*. Two concentrations of the amino-acid mixture were used. Solution I was made up to contain approximately the concentration of each amino-acid that was found by White to be the optimum for root growth. Solution II was ten times the concentration of solution I.

Treatment 1. Cuttings after α-naphthalene acetic acid treatment were kept with about ¾ in. in solution I in a heated frame at 22° C. for eight days (the amino-acid solution was changed twice during treatment).

Treatment 2. Cuttings soaked for twenty-four hours in solution II.

Treatment 3. Cuttings soaked in water for eight days.

Treatment 4. Cuttings soaked in water for twenty-four hours.

After treatment the cuttings were planted in sand.

After four weeks the cuttings from treatment 1 showed marked swelling of the base of each cutting accompanied by the splitting of the epidermis. There were no signs of callus formation. Cuttings from treatment 2 showed similar enlargement of the base but this was not quite so marked, while those from treatments 3 and 4 showed definite callus formation but no swelling of the base.

After six weeks all cuttings from treatment 1 (10 cuttings in all) were rooted. Six cuttings from treatment 2 were rooted—after seven weeks all were rooted. No roots were on cuttings from treatments 3 and 4, even after seven weeks, though callus formation was marked.

The results indicate that one (or more) of the amino-acids used has had a marked effect on the production of roots. This observation substantiates the prediction of Went *et al.* that rooting of some cuttings may be limited by lack of amino-acids.

Experiments to indicate which of the individual amino-acids was responsible for the observed effect are under way.

B. W. DOAK.

Plant Chemistry Laboratory,
Department of Scientific and
Industrial Research,
Palmerston North,
New Zealand.
June 19.

[1] Went, F. W., Bonner James and Warner, G. C., *Science*, **87**, No. 2251 (1938).
[2] White, P. R., *Plant Physiology*, **12** (1937).

Hydrolysis of Starch Films by Polarized Infra-Red Radiation

IT was shown in 1924 that, in the presence of small quantities of diastase at room temperature, plane-polarized daylight has a selective effect in accelerating the hydrolysis of starch grains[1].

In the case of the temporary starch in the living leaf very marked evidence of hydrolysis was observed on irradiation with daylight polarized by a Nicol prism, a well-defined image of the prism aperture being obtained, when the irradiated leaf was treated with iodine solution[2].

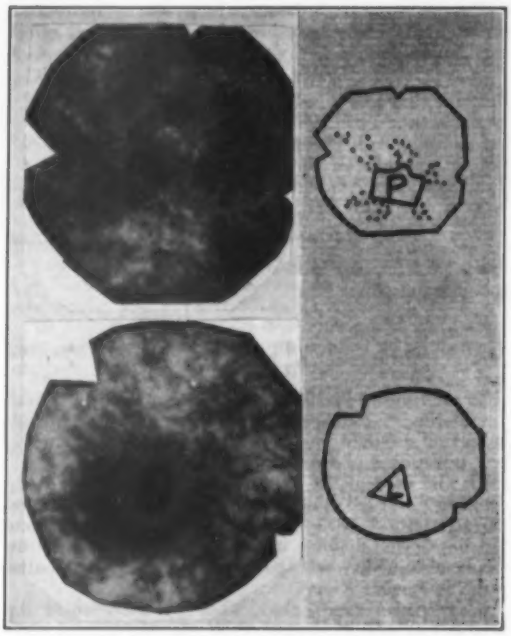
It was also shown that, when the stomata in the living leaf are irradiated with plane-polarized daylight, the rate of hydrolysis of the starch in the guard-cells is sufficient to burst them[2].

Furthermore, films of starch solution on glass and on filter paper were irradiated with plane-polarized light and convincing evidence of hydrolysis was obtained. The starch films on glass after irradiation deposited crystals on drying. The starch films on filter paper were treated with iodine solution after irradiation and the resulting blue colour was much less pronounced in those portions of the film which had been exposed to the polarized radiation.

In 1936 Prof. Baly directed my attention to the fact that carbohydrates do not selectively absorb rays in the visible and near ultra-violet regions of the spectrum, but selectively absorb rays in the wavelength region 1·5 μ–6 μ, and he suggested the use of polarized infra-red radiation.

The radiation from a roll of fine platinum gauze heated in a Bunsen burner was reflected upwards, (*a*) by a sheet of ferrotype at the polarizing angle, and (*b*) from a polished metal surface which had been lightly greased in order to reduce the intensity. These two reflected beams, one plane-polarized and the other non-polarized, irradiated moist starch films on filter paper in petri dishes. In each case a diaphragm with an aperture cut in it was interposed, the shapes of the two apertures being purposely different, as shown by the accompanying line diagrams.

After being irradiated for 2–3 hours, the starch films were allowed to dry in a dark room and then treated with iodine solution and *thoroughly* washed (to remove dextrins). As may be seen from the photograph (top) the effect of the polarized radiation is shown by a lighter coloured area which corresponds in shape to the aperture *A* in the diaphragm. The definition of this lighter area is somewhat marred by the diffusion of the products of hydrolysis into the non-irradiated area. It may be noted that this diffusion does not take place in the living leaf, owing to the starch grains being enclosed in cells, and



STARCH FILMS AFTER STAINING WITH IODINE (LEFT). *P* SHOWS DIMINUTION OF STARCH, THE DOTTED LINES INDICATING STREAMS OF HYDROLYSED PRODUCTS. *L* SHOWS CONDENSATION

consequently the image of the aperture of the Nicol prism was much more clearly defined as stated above.

In the control shown in the lower photograph the reverse effect was observed with non-polarized infra-red radiation, the irradiated area giving a darker colour on treatment with iodine solution.

This result would seem to give definite evidence that starch is hydrolysed by polarized infra-red radiation.

I have to express my thanks to Prof. Baly and also to Mr. Riddell, director of the Folkestone Technical Institute, for the excellent facilities which enabled the observations with infra-red radiation to be made.

ELIZABETH SIDNEY SEMMENS.
University of London Club,
Gower Street, W.C.1.
June 19.

[1] Baly and Semmens, *Proc. Roy. Soc.*, B, **97**, 250.
[2] Semmens, *Bot. Gaz.*, 412 (Dec. 1930).
[3] Semmens, NATURE, **134**, 813 (1934).

Reciprocal Hetero-Transplantation of Limb Primordia between Duck, Turkey, Guinea and Chick Embryos

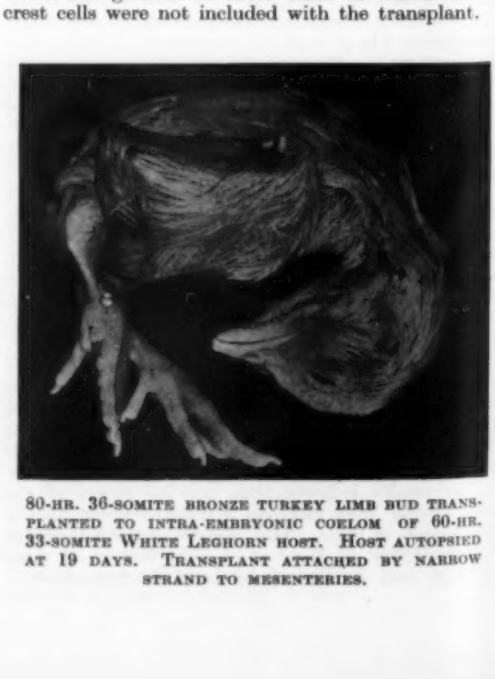
SUCCESSFUL transplantation of a chick limb bud to a turkey host was demonstrated by Eastlick[1] in 1939. Since that time, a number of grafts have been made by transplanting wing or hind limb primordia to the intra-embryonic cœlom or lateral body wall of a variety of hosts. Normal shaped limbs have been secured in reciprocal grafts made between chicken and turkey, duck and chicken, guinea and chicken, and turkey and guinea embryos.

That the limb primordia are self-differentiating is shown by the fact that many of the buds placed within the intra-embryonic cœlom develop although attached to the host mesenteries by only an artery and vein. In such cases the skeletal elements are well formed, but the muscles appear to undergo fatty degeneration. Other grafts attached to the flank of the host become innervated and seem to possess normal musculature.

While numerous examples of the above-mentioned types of grafts have been obtained, the majority of the hosts died before the time of hatching. This appears to be due to the fact that the grafts attached to the flank usually crowd the host within the shell and hence weaken it, while those grafts made into the cœlom seem to interfere with the retraction of the yolk sac. In five cases, to date, hatching has occurred and the birds have survived. One chick, killed 24 hours after hatching, was found to have a duck leg within its cœlom. A second chick with a duck leg attached to its flank still survives. The additional leg has a webbed foot and is in good proportion, with the exception of a missing toe. The leg seems to be innervated but cannot be flexed. This leg has increased in size since the time of hatching.

Three chicks have hatched with guinea legs attached to their flanks. All four of the above-mentioned chicks are being kept alive for further study. A number of turkey hosts bearing chicken legs and chicken hosts bearing guinea limbs have broken the shell but were too weak to survive.

Dorris[2] first reported that the melanophores of the fowl are derived from the neural crest. Eastlick[3] substantiated this observation by grafting limb bud of Barred Rock embryos to White Leghorn hosts. Those limb primordia, which included neural crest cells, developed pigmented down, while those from which the neural crest cells were excluded bore non-coloured plumage. Similar results have been secured in this study, since non-coloured plumage developed on limbs secured from mallard ducks, Bronze turkeys and Pearl guineas in those cases in which neural crest cells were not included with the transplant.



80-HR. 36-SOMITE BRONZE TURKEY LIMB BUD TRANSPLANTED TO INTRA-EMBRYONIC COELOM OF 60-HR. 33-SOMITE WHITE LEGHORN HOST. HOST AUTOPSIED AT 19 DAYS. TRANSPLANT ATTACHED BY NARROW STRAND TO MESENTERIES.

When neural crest cells were included with the limb primordia of Bronze turkey and mallard duck embryos and the transplants made to the flanks of White Leghorn chickens, it was found that the lateral body walls of the hosts became pigmented by the migration of donor melanophores. Such evidence of migration has not been observed when guinea limb buds containing neural crest cells were transplanted to White Leghorn embryos.

HERBERT L. EASTLICK.

University of Missouri,
Columbia, Mo.
July 7.

[1] *Anat. Rec.*, **73**, 17 (1939).
[2] *Proc. Soc. Exp. Biol. and Med.*, **34**, 448 (1936).
[3] *Genetics*, 24, 98 (1939).

Fire-Fly 'Spinthariscope'

IT must be well known that the lantern of a fire-fly, teased by being held with the fingers, emits irregular flashes from minute point-sources in the lantern which follow the normal flash, the light of which fills the entire lantern. I am wondering, however, if the very astonishing spectacle presented by a fly which has been bitten by a spider has been described. Within a few minutes after a few 'nips' have been made by the spider, if the fly is removed from the web, the lantern will be observed to glow with a faint green light which shows the same 'shimmering' quality as the radium paint on the dial of a watch. Examination with an ordinary hand magnifying glass, of moderate power, shows the lantern filled with bright points of light, which at first sight appear to be in rapid vibratory motion, and at the end of half an hour we have a seething cauldron of hundreds of bright points, dancing and flashing, and giving an almost perfect picture of a screen of zinc sulphide under a terrific bombardment of 'alpha' particles (spinthariscope). The phenomenon persists with undiminished intensity for forty-eight hours but finally dies out, the fly apparently having returned to normal. The spinthariscope effect is frequently accompanied by an occasional normal flash, which ceases if the fly is decapitated, though the other effect continues. The normal flash of the lantern is obviously due to the simultaneous excitation of all the luminous centres by nerve impulses from the brain, but the scintillations persist even after the lantern has been severed from the body. Both types of illumination cease if the fly is placed in a narrow glass tube through which a stream of carbon dioxide is flowing. I have produced the spinthariscope effect by innoculations with 1 : 1000 solution of snake venom, but in this case the fly did not recover.

Under a microscope, with a low-power objective, the individual flashes of green light are seen against a black background and the strong vibratory movement seen with a hand magnifier appears to be due chiefly to the quenching of a flash at one point accompanied by the successive flash of a luminous centre in its immediate vicinity. My impression is, however, that I have seen single flashes quiver, though in this case it may be merely the spreading of the chemical reaction which produces the light, from one part of a cell to another. The phenomenon, seen with the microscope, is really an amazing sight.

The spiders were, in most cases, small ones found in window webs, with bodies not much larger than a grape-seed, and they usually make their first bites on the leg joints of the fly. The sparkling green flashes appeared first along the upper edge of one or both of the two lanterns, sometimes on one side only. The phenomenon then spread rapidly throughout the entire volume of the lantern. It seems possible that some information about the nervous system of the fly might be gained by recording the position of points innoculated by the spider and the point, or points, in the lantern at which the scintillations first appear, but the problem is one for a biologist rather than a physicist.

R. W. WOOD.

East Hampton,
Long Island,
New York.
July 22.

Role of Phosphate in Pyruvic Acid Dehydrogenation

DURING earlier work[1] on the problem of pyruvic acid dehydrogenation with *Bacterium acidificans longissimum* (Delbrückii), it was found that in the absence of inorganic phosphate no reaction took place, and at low concentrations of phosphate the rate of dehydrogenation was proportional to concentration. This indicated that inorganic phosphate must in one way or another participate in the reaction. Such a view was further strengthened when it was found that pyruvic acid dehydrogenation was able to promote adenylic acid phosphorylation[2]. The supplying of active phosphate by a dehydrogenation reaction had only been observed with the phosphoglyceric aldehyde dehydrogenation[3,4]. Recently Negelein and Brömel[5] were able to isolate as the primary product of this dehydrogenation a labile di-phosphoglyceric acid which they assumed to be either a 1-3-phospho- or a pyrophospho-compound, probably the former. The remarkable finding of Negelein and Brömel induced me to see whether during dehydrogenation of pyruvic acid to acetic acid an intermediary phosphate compound occurred.

Acetylphosphate was prepared from trisilver phosphate and acetylchloride according to the method of Kämmerer and Carius[6]. For the present no serious attempt has been made to isolate the assumed intermediate mono-acetylphosphate, but a solution containing a mixture of the mono-, di-, and tri-acetylphosphates, in addition to acetate, chloride, and some inorganic phosphate, was used for experiments with dry preparations of *Bacterium Delbrückii*. The average stability of the bound phosphate in the solution corresponded roughly to that of creatine phosphate. The content of bound phosphate was estimated by the early method of Eggleton for creatine phosphate.

In the following experiment the colorimetric method of Lohmann and Jendrassik was used, where acetylphosphate, like creatine phosphate, finally appears as inorganic phosphorus. 44 mgm. dry bacteria were used per vessel, in a total volume of 1·25 ml. containing 0·04 *M* fluoride. The suspension was shaken at 37·5° for sixty minutes in nitrogen :

	0·75 mgm. acetyl-P	0·75 mgm. acetyl-P 4·0 mgm. adenylic acid	0·75 mgm. acetyl-P 0·1 mgm. adenylic acid
Mgm. inorganic and acetyl-P	1·12	1·39	1·37
Mgm. pyrophosphate-P	0·35	0·09	0·10

The experiment shows that after incubation with adenylic acid about 30 per cent of the phosphate of the added acetyl-phosphorus appears in the pyro-

phosphate fraction, corresponding to a phosphorylation of about 25 per cent of the added adenylic acid.

From the results of this and similar experiments and the earlier work mentioned above, it is concluded that the dehydrogenation of pyruvic acid proceeds according to the following formulation:

$$\text{pyruvate} + \text{phosphate} - 2\text{H} \rightarrow \textit{acetylphosphate} + \text{CO}_2$$

$$\textit{acetylphosphate} + \text{H}_2\text{O} \xrightarrow{\text{(or adenylic acid)}} \text{acetic acid} + \text{phosphate (or adenosinepolyphosphate)}$$

In investigations of pyruvic acid metabolism it has long been puzzling that, although the oxidative breakdown of pyruvic acid has been found to go through a stage corresponding to acetic acid, added acetic acid is inactive in systems oxidizing pyruvic acid completely. The intermediate formation of acetylphosphate provides a reasonable explanation for the 'active' acetate, and for various acetylation processes connected with the oxidative breakdown of pyruvic acid and carbohydrate, for example, acetylation of amino-acids[7] and of choline[8].

Further details will appear in vol. 7 of the Cold Spring Harbor Symposium on Quantitative Biology.

Acknowledgment is made of a grant from the Ella Sachs Plotz Foundation.

FRITZ LIPMANN.

Department of Biochemistry,
Cornell University Medical College,
New York City,
and
Biological Institute
of the Carlsberg Foundation,
Copenhagen.
July 21.

[1] Lipmann, *Enzymologia*, **4**, 65 (1937).
[2] Lipmann, NATURE, **143**, 231 (1939).
[3] Meyerhof, Ohlmeyer, and Möhle, *Biochem. Z.*, **297**, 90 (1938).
[4] Needham and Lu, *Biochem. J.*, **32**, 2040 (1938).
[5] Negelein and Brömel, *Biochem. Z.*, **301**, 135 (1939).
[6] Kämmerer and Carius, *Ann.*, **131**, 165 (1864).
[7] du Vigneaud and Irish, *J. Biol. Chem.*, **122**, 349 (1937-38).
[8] Mann, Tennenbaum and Quastel, *Biochem. J.*, **32**, 243 (1938).

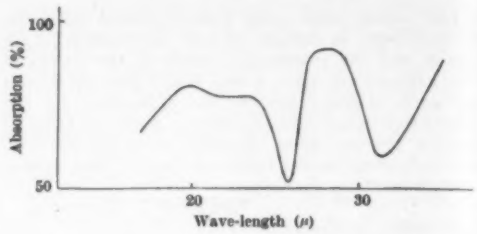
Structure of the Tetrachlorethylene Molecule

THE suggestion has been made by one of us that the vibration spectrum of tetrachlorethylene cannot be interpreted properly by a potential function involving only four or even seven force constants[1]. By considering the physical meaning of the 'cross-terms', a potential function was chosen the expression for which contained thirteen force constants, the values of which were determined from experimental data. The prediction was made that two fundamental frequencies, of symmetries A_1 and A_2 respectively, occur in the far infra-red, at 400 cm.$^{-1}$ and 346 cm.$^{-1}$.

Measurements have been made with the 'residual ray' apparatus, and with a grating spectrometer, described elsewhere[2]. The accompanying curve (obtained by the second method) shows the absorption in the region 30 μ, due to tetrachlorethylene dissolved in paraffin.

The frequencies of the two absorption bands are 387 cm.$^{-1}$ and 332 cm.$^{-1}$, in good agreement with the theoretical values. The slight differences may be due to the neglect of the anharmonicity and to the fact that the computed values refer to the gaseous and not to the dissolved state as in our experiments.

From the above results, it is now clear that the frequencies in the spectrum of tetrachlorethylene



cannot be correlated by means of a simple potential function as suggested before by one of us[3], and by Linnett and Thompson[4]. For example, a valency force field should give 604 cm.$^{-1}$ instead of 387 cm.$^{-1}$ for A_1.

On the other hand, it is still difficult to determine exactly the value of the C—C force constant because the interaction terms are insensitive to its variation. However, it may be substantially less than $8{\cdot}5 \times 10^5$ dynes/cm. as in ethylene; and the suggested structure arising from resonance between the C—C bonds is not to be excluded since the interaction terms of the form f_C $\Delta_{C\text{-}C}$ $\Delta_{C\text{-}Cl}$ and γ_C $\Delta_{C\text{-}C}$ $\Delta_{Cl\text{-}C\text{-}Cl}$ are very important ($\sim 1{\cdot}70 \times 10^5$ dynes/cm.).

Complete details will be published shortly elsewhere.

One of us (J. D.) wishes to express his thanks to Prof. C. Manneback for helpful correspondence during the preparation of the note on which the present one is based.

JULES DUCHESNE.

Mathematics Department,
Imperial College of Science and Technology,
London.

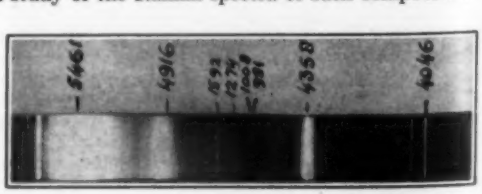
MAURICE PARODI.

Laboratory of Physical Researches,
Sorbonne, Paris.

[1] Duchesne, J., NATURE, **142**, 256 (1938).
[2] Parodi, M., Thesis (Hermann, Paris, 1938). Barchewitz, P., and Parodi, M., *J. Phys.*, **10**, 143 (1939).
[3] Duchesne, J., NATURE, **139**, 288, 634 (1937).
[4] Linnett, J. W., and Thompson, H. W., *J. Chem. Soc.*, 285, 1393 (1937).

Structure of *p*-Diphenylbenzene and its Raman Spectrum

THERE have been very few structure determinations of aromatic compounds which contain three benzene rings. The structure of *p*-diphenylbenzene of the diphenylbenzene family has been studied by L. W. Pickett[1] by the method of trial and error and Fourier analysis, and this tends to show that the molecule of this compound is planar in form. In the present investigation our object is to attack the problem from a study of the Raman spectra of such compounds.



SPECTRUM OF 4358 A. MERCURY RADIATIONS SCATTERED BY SOLID *p*-DIPHENYLBENZENE.

In a previous note[1], one of us and S. Abdul Aziz have submitted the results of our investigation on the meta- and the ortho-compounds of this family. We have now also succeeded for the first time in obtaining the Raman spectra of *p*-diphenylbenzene in the solid state, and in spite of the very strong fluorescence shown on the plates, as the photograph reproduced here will show, the substance has yielded 24 new lines not recorded before. The frequencies obtained are at 3041(3), 2824(0), 2205(½), 2140(½), 2095(3), 2029(3), 1760(1), 1673(0), 1605 (10), 1592(10), 1549(3), 1503(1), 1372(0), 1274(10), 1219(6), 1148(0), 1039(1), 1008(4), 981(4), 811(0), 773(5), 598(½), 85(5), and 42(5) cm.$^{-1}$ respectively. (Intensities are given in brackets.)

p-Diphenylbenzene has three benzene rings joined in the *para* position, and the central ring with each of the end ones may be considered to constitute a diphenyl molecule. Diphenyl[2], which consists of two benzene nuclei joined end on by a C–C bond in the *para* direction, has been shown to be planar, and all the important frequencies found in diphenyl by one of us[2] and also by Wood[4] and others[5] are observed also in *p*-diphenylbenzene. These diphenyl frequencies are at 1610(10), 1590(8), 1544? (Wood), 1283(10), 1032(3), 1003(10), 980(1) and 779 cm.$^{-1}$ respectively. A comparative study of the spectra observed in these two compounds lends support to the view that the molecule of *p*-diphenylbenzene is planar in form.

Further investigation is proceeding and details will be published elsewhere.

S. K. MUKERJI.
LAKSMAN SINGH.

Physics Department,
Agra College, Agra.
July 7.

[1] *Proc. Roy. Soc.*, A, **142**, 333 (1933); NATURE, **131**, 513 (1933).
[2] Mukerji, NATURE, **142**, 477 (1938).
[3] *Ind. J. Phys.*, **7**, 43 (1932); also Mukerji and Aziz, *Ind. J. Phys.* 13, Pt. IV (Aug. 1938).
[4] Wood, *Phys. Rev.*, **36**, 1431 (1930); **38**, 2168 (1931).
[5] Dadieu and Kohlrausch, *Sitzber. Akad. Wiss. Wien*, Abt. IIa, **138** 799 (1929); Donzelot and Chaix, *C.R.*, **201**, 501 (1933).

Dunstan's Law

DUNSTAN'S law[1] for viscosity is given by

$$\log \eta = aM + b,$$

where η is viscosity of liquid at a definite temperature, say 20° C.; M is the molecular weight of the liquid; a is a general constant; and b is a specific constant characteristic for any one homologous series.

I have derived this law from theoretical considerations; but the important point is that this derivation also defines the limitations of the law in more rigorous manner. Andrade's equation is now universally accepted:

$$\eta = Ae^{B/T},$$

where A and B are constants and T is absolute temperature of measurements. A recent rendering of this equation is:

$$\eta = \frac{Ml}{Ae^{n\overline{RT}}};$$

where l is the latent heat of vaporization, and n is a characteristic constant between 2·5 and 4·0 approximately, for ordinary liquids.

Similarly, vapour pressure is given by

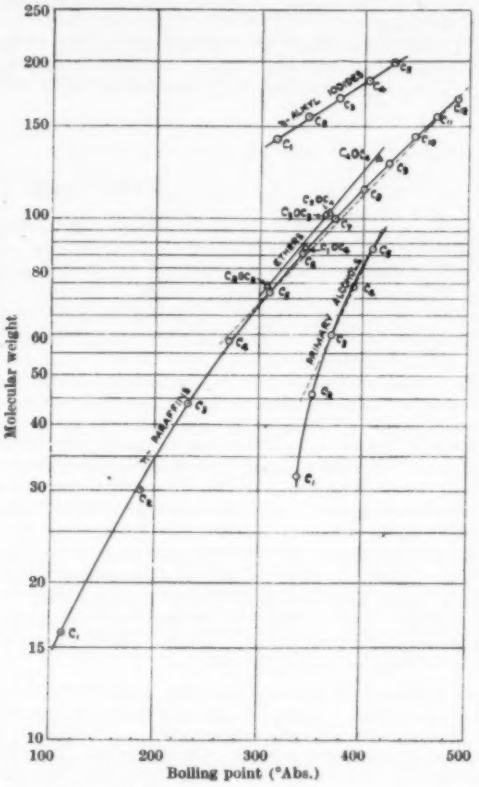
$$P = Ae^{-Ml/RT}$$

and the Clausiust-Clapyron rendering of this formula is

$$\log\left(\frac{P_1}{760}\right) = -\frac{Ml}{2{\cdot}3\,R}\left[\frac{1}{T_1} - \frac{1}{T_B}\right];$$

where the suffix B denotes boiling point.

Thus $\log\left(\frac{P_1}{760}\right) = -\frac{Ml}{2{\cdot}3RT_B}\left(\frac{T_B}{T_1} - 1\right) = -K\left(\frac{T_B}{T_1} - 1\right)$, since $\frac{Ml}{T_B}$ = constant from Trouton's rule.



It follows then that

$$\log \frac{\eta_1}{\eta_B} = K'\left(\frac{T_B}{T_1} - 1\right).$$

This last formula means that if $\log \eta$ is plotted against values of T_B/T for an homologous series like the normal paraffins, only one line is obtained. Such a graph was published in the literature recently[2].

Hence

$$\log \eta = K'T_B + K''$$

for an homologous series if a standard temperature, say 20° C., is chosen for T_1.

The accompanying graph shows that $\log M$ plotted against T_B for normal paraffins yields a curve: but if the portion appropriate to the liquids n–C_5H_{12} up to n–$C_{12}H_{24}$ be taken, a straight line would roughly pass through it. Thus, with approximation and limiting the carbon atoms to those mentioned,

$$T_B = A \log M + B.$$

Hence $\log \eta = A' \log M + B'$,

which is Dunstan's law in a more exact form.

It is clear, then, that this law is limited by the following considerations:

(1) It can only apply to those homologous series which yield a solitary curve for log η *vs* T_B/T for all their members. Since first members in homologous series generally do not lie on these curves—for reasons which will be detailed in a later publication—it will not apply to first members of homologous series.

(2) The law can only apply to those homologous series which will yield approximately straight lines for log M *vs* T_B. Again, it is seen that first members will be excepted.

(3) When the effects of a certain radicle, say CH_2, are studied in different series, say alkyl iodides, *n*-paraffins and alcohols, the increment in log η due to CH_2 will be the same only for those series which have parallel straight lines for log M *vs.* T_B. Thus the iodides have been found to possess smaller values for the increment in log η due to CH_2 than the *n*-paraffins, whilst the alcohols possess greater values, and the ethers have identical values.

(4) The law is approximate only, even for *n*-paraffins.

A. H. NISSAN.

Dept. of Oil Engineering and Refining,
The University, Birmingham, 15.
June 27.

[1] Hatschek, E., "The Viscosity of Liquids", 108 (1928).
[2] Nissan, A. H., and Clark, L. V. W., NATURE, 143, 722 (1939).

Points from Foregoing Letters

D. Y. Solandt and C. H. Best, from experiments made with rats, conclude that deficient vagus function may be associated with a diet poor in choline and that this may, in part at least, be rectified by injected choline. Thus, it is suggested that choline deficiency may result in deficient formation of acetylcholine at the nerve endings.

A. S. McFarlane and M. G. Macfarlane report the presence in vaccinia virus of two types of lipoid, and of nucleic acid. The behaviour of the virus to mechanical treatment, to lipoid solvents, and to the action of sodium carbonate suggests that forces are present which are able to preserve the form of the particles in the absence of any demonstrable cell membrane.

F. L. Hopwood, M. H. Salaman and A. S. McFarlane find that dried vaccinial elementary bodies which have been extracted with benzene may be completely redispersed by means of ultrasonic vibrations. The virus particles so obtained have lost none of their original infectivity.

L. Halberstaedter finds that the hamster reacts to the subcutaneous injection of benzpyrene by tumour formation like the rat and mouse. Apart from a shorter incubation period, there are no peculiar features in the formation of the primary tumours. Passaging of a benzpyrene tumour in hamsters resulted in a remarkably high percentage of animals developing metastases, which were always localized in the lymph glands. This property is regarded as a peculiarity of this strain.

Unfertilized eggs of a sea-urchin have been inseminated immediately after irradiation with alpha-rays from radium C′ by M. Miwa, H. Yamashita and K. Mori. They find that the start of cleavage is delayed in some eggs, and with increasing doses of irradiation the number of eggs showing normal cleavage decreases; in some eggs cleavage stops altogether and disintegration occurs.

B. W. Doak finds that treatment of rhododendron cuttings which had already received a root-forming hormone with a mixture of certain amino-acids promotes root formation, thus substantiating a prediction by Went *et al.* that rooting of some cuttings is limited by lack of amino-acids.

Elizabeth S. Semmens states that the selective effect of polarized radiation in the hydrolysis of starch, both in the starch grain *in vitro* and in the living plant, is confirmed by a similar action on films of boiled starch, thus showing the effect to be a physico-chemical one. That the result is mainly due to the infra-red portion of the spectrum is demonstrated by the use of heated platinum gauze as a source.

H. L. Eastlick reports that reciprocal transplants of limb primordia have been made between $2\frac{1}{2}$ and $3\frac{1}{2}$ day duck and chicken, turkey and chicken, guinea and chicken, and turkey and guinea embryos. The transplants grew attached to the body wall or to the cœlom of the hosts and the limbs thus obtained are normal in appearance. The flank grafts seem to be innervated. Several chicks bearing duck and guinea limbs have hatched and in at least one instance the additional leg is increasing in size.

R. W. Wood states that the scintillations given out by the 'lantern' of a fire-fly bitten by a spider when observed under low magnification have a similar appearance to a zinc sulphide screen under alpha-particle bombardment. Study of the origins of scintillations in relation to the position of the bite might give information about the nervous system of the fly.

F. Lipmann puts forward a scheme for the dehydrogenation of pyruvic acid by *Bacterium Delbrückii* which involves the formation of acetylphosphate as an intermediate stage.

The absorption curve in the region 30 μ for tetrachlorethylene dissolved in paraffin is submitted by J. Duchesne and M. Parodi. The frequencies of the two absorption bands observed are in agreement with the predictions of a theoretical discussion of the vibration spectrum of this substance.

S. K. Mukerji and L. Singh have investigated the Raman spectrum of solid *p*-diphenylbenzene, and deduce that the molecule is planar.

Dunstan's law for the relationship of viscosity with the molecular weight of members of an homologous series is derived by applying Trouton's rule to the Clausius-Clapyron and Andrade equations. The limitations of the law become apparent from this derivation and it is shown by A. H. Nissan that the equation $\log \eta = K'T_B + K''$ is the fundamental one giving rise to Dunstan's $\log \eta = aM + b$ only in certain cases.

RESEARCH ITEMS

New South African Stone Age Cultures

DR. E. G. N. VAN HOEPEN in his presidential address to Section E of the South African Association for the Advancement of Science on July 5, 1938 (*Argeologiese Navorsing Nas. Mus.*; **9**, 10, 1939), in discussing certain aspects of South African archæology, adduced argument for the conclusion that there had been in the Stone Age in South Africa, as in Europe, two civilizations, existing side by side simultaneously, of which one was characterized by implements made on cores ('Fauresmith', Vaal, Stellenbosch), and one by implements made of flakes (Koning, including three industries, Wilton, Smithfield, Koning; Mossel Bay; and Pniel). Further research and exploration have since brought to light new cultures, confirming and extending the application of this view. A number of cleavers from Wellington made from river boulders, one side showing the original surface, are of more primitive form than the Vaal cleavers, and though Pniel in shape and technique, represent an earlier flake industry, which it is proposed to call the Wellington industry, to distinguish it from the Pniel industry, in conjunction with which it constitutes the Pniel culture. It is contemporary with Stellenbosch. A second new culture comes from the Brakfontein farm, and is a congeries of flakes and implements which cannot be placed in any of the known industries. The flakes are large, a breadth of twelve inches being not uncommon. More often the implements are broader than they are long. Flakes have been made into implements by secondary trimming of the edge opposite the bulb of percussion. They resemble flaying knives from the Koning industry, but are larger and cruder. Probably Koning is derived from them. Two other localities are known but not yet worked. The Brakfontein culture, as it is proposed to call it, may have been contemporary with earlier Mossel Bay, to which belong a number of long flakes recently found at Swartfontein with 175 hand-axes of the Vaal and Stellenbosch cultures. The Swartfontein flakes are distinct from the Mazelspoort, and it is proposed to differentiate the two as the Swartfontein and Mazelspoort industries, constituting together the Mossel Bay culture.

Chromosomes of the Pig

F. A. E. Crew and P. C. Koller (*Proc. Roy. Soc. Edin.*, **59**, 163–175; 1939) show that the chromosome complement of the pig is $2n = 38$, with a range in chromosome size of $7{\cdot}5\,\mu$–$1{\cdot}5\,\mu$. There is little, if any, terminalization between mid-diplotene and metaphase, and the chiasma frequency in some chromosomes appears to be proportional to the length of the chromosome. The five larger bivalents exhibit localization of chiasmata; consequently, recombination of genes on these chromosomes is expected to be peculiar and limited. The *Y*, with a sub-terminal centromere, pairs with one arm of the medianly attached *X*, while the other arm of the *X* chromosome appears to be the differential segment. Pre-reduction is obligatory in the *XY* bivalent. Evidence of at least one inversion is given.

Chromosome Rearrangements in Drosophila

B. P. KAUFMANN (*J. Hered.*, **30**, 171–190; 1939) irradiated Drosophila males and studied the salivary gland chromosomes of the progeny. Deficiencies, duplications, translocations, transpositions (intra-chromosomal translocations) and multiple exchanges involving up to eight breaks were found. The author points out that chromatid and chromosome breaks caused by X-rays do not provide unequivocal evidence for the time of chromosome splitting.

Temperature Rhythm in an Ant-hill

THE temperature changes within the mound of a widely distributed species of Japanese ant, *Formica truncorum truncorum* var. *yessensis*, have been investigated by Mutsuo Katô (*Sci. Rep. Tôhoku Imp. Univ.*, 4 Ser., **14**, 53; 1939). The diurnal temperature rhythm in the interior of the mound was remarkably different from that of the air temperature, for at a depth of 20 cm. or more below the surface it was almost constant, ranging only from 26·1° to 28·8° C. Even at a depth of 10 cm. the temperature was fairly constant (24·6°–30·9° C.), but at lesser depths the influence of the rhythm of solar radiant energy became more and more apparent as the surface was approached. The mounds are composed of masses of withered grass, bits of leaf-stalks and twigs loosely piled on bases of living trees or stumps; they are thus partially insulated by the content of air interlaced in the material of the mound. Nevertheless artificial mounds showed, at corresponding depths, greater temperature fluctuations than the ant-hills, and this was due to temperature regulation within the latter. The main source of heat is undoubtedly the sun, and although during periods of activity the ants may add a little to the sum total, further regulation of the internal temperature is brought about by the opening and closing of the entrances to the mound. When the day is declining many ants carry material which is used in blocking the passages made for exit during the day-time, and thus the loss of heat which would take place during the night is reduced.

Market Economics of the Apple

AN interesting study of the complex relations between quality and price of McIntosh apples sold in the New York City markets has been made by John R. Raeburn (*Cornell Univ. Agr. Exp. Sta. Mem.* No. 220. Ithaca, U.S.A., March 1939). The average diameter, the amount of red-coloured skin, the practice of 'facing' or having the top layer of apples superior to the general sample, and serious and not-serious defects produced by insect attack, by fungal parasites or by bruising, all affect the price received. Their effects are interrelated, and a method of surface correlation involving the presentation of data in three dimensions has been used to reveal the joint effects of two variables upon the dependent variable, price. One important result of the study concerns the economic effects of high-quality grading. Separation of the highest quality fruit does not produce the greatest financial return; the utilitarian needs of the ultimate consumer provide a surer basis for grading. Prices recorded in the

present investigation indicate the gastronomic, rather than the æsthetic, value of the fruit. Serious and not-serious defects affect prices jointly, for the influence of one type depends upon the proportion of the other. This finding vindicates the numerous recent studies of pests or parasites which have little effect upon their hosts. They predispose the market against even slight occurrences of more serious defects. The paper under review gives many other detailed correlations, several of which are crystallized into definite recommendations for the farmer or the market organizer.

Observation of Growing Roots

OBSERVATION trenches for the examination of roots in the field are described by W. S. Rogers (*J. Pom.*, 17, 99; 1939) in an account of four years' work on the growth of apple roots at East Malling. The trenches, which were 4 ft. 6 in. deep and 2 ft. 6 in. from the tree trunks, were provided with plate-glass windows held against the soil profile. They were enclosed to form wooden cabins and protected from light. 14 year-old Lane's Prince Albert apple trees were observed over four years and the time and rate of root growth, suberization and formation of laterals recorded. During active growth, the rate of root elongation approximated 3 mm. per day, while suberization occurred when the roots were a week to a month old. Small roots died and disappeared after suberization. Larger ones persisted, often with rapid secondary thickening, and produced laterals. Root growth was closely correlated with soil temperature, very little growth occurring in winter at soil temperatures from 35° F. to 45° F. Active growth began at about 45° F. and increased up to 69° F. (at 8 in. deep). It began before the leaves unfolded, and continued after shoot growth ceased. A fall in soil moisture checked root growth though the moisture content was still well above the wilting range. In spring, most root growth occurred in the warmer surface layers of soil and in winter in the lower layers. The greatest concentration of roots occurred at a depth between 5 and 30 inches. A comparison of trees on stocks I, IX and XVI showed that the amounts of root corresponded with the relative vigour of the stocks, but the mean growth-rate per root was similar for all stocks. It appeared that physiological differences between the rootstocks were relatively small.

Apparent Shape of Protein Molecules

IT has been recognized for some time that protein molecules are probably not spherical and the term dissymmetry constant was introduced by Svedberg for the ratio f/f_0, where f and f_0 are the measured molar frictional coefficient (derived from sedimentation and diffusion experiments) and the theoretical value for a spherical molecule of the same molecular weight, respectively. H. Neurath, (*J. Amer. Chem. Soc.*, 61, 1841) has applied Perrin's diffusion equation to the problem, this equation involving the long and short axes of a prolate ellipsoid of revolution. The results are subject to large limits of error but they show that, with a few exceptions, protein molecules are not spherical, and most exhibit high molecular dissymmetry. Proteins which belong to different groups as regards their molecular weight become members of the same group if arranged according to their molecular dimensions. Thus, cytochrome C, gliadin and erythrocruorin, with molecular weights of 15,600, 26,000 and 31,400, have a common short diameter of about 18 A. Comparison of the dimensions of proteins with those of their respective dissociation and aggregation products indicates that cleavage occurs only in directions parallel to either the major or minor molecular axis.

Diffusion Velocity and Molecular Weight

CONSIDERABLE interest has recently been shown in the use of diffusion velocity in determining molecular weights, calculations having usually been made by the Stokes-Einstein diffusion equation: $D = (RT/N) \cdot 1/(6\pi\eta r)$. L. Friedman and P. G. Carpenter (*J. Amer. Chem. Soc.*, 61, 1745; 1939) point out that the diffusion coefficient to be used in this equation should be that at infinite dilution, and by plotting diffusion coefficients against the square root of the concentration and extrapolating the straight line to zero concentration for some sugars and salicin, they find reasonable values of the molecular weights. An experimental study of the diffusion velocity of glucose by this method gave the correct molecular weight. It is pointed out that the relationship holds for a substance of molecular weight as low as 180, whereas most investigators have felt that the Stokes-Einstein relation could not be applied to substances of such low molecular weight.

Detection of Carbon Disulphide Vapour

LEAFLET No. 6 of the series by the Department of Scientific and Industrial Research on methods for the detection of toxic gases in industry deals with carbon disulphide vapour (H.M. Stationery Office. 3*d*. net). It is stated that the permissible concentration of carbon disulphide vapour in the atmosphere of work-rooms should be kept well below one part in 30,000 of air and preferably below one part in 100,000. The method of detection of the vapour depends on its interaction with diphenylamine and copper acetate to produce a coloured compound, copper diethyldithiocarbamate, and full instructions for carrying out the tests are contained in the leaflet, which is bound in strong paper covers.

Impurities in Brass

FOR the last seven or eight years, on the recommendation of the American Society for Testing Materials, the Non-Ferrous Ingot Metal Institute has supported a research on the effects of impurities and heat treatment on the physical properties of brass which has been carried out by H. B. Gardner and C. M. Saeger at the National Bureau of Standards. Two papers on the effects of pouring temperature and of sulphur and iron impurities have already been published, and in the June issue of the *Journal of Research* of the Bureau a third on the effects of aluminium and of antimony appears. Cast red brass of composition 85 per cent copper, 5 per cent each tin, zinc and lead was remelted and up to 0·10 per cent aluminium or 0·23 per cent antimony added and specimen bars cast at temperatures from 1230° to 1065° C. in chilled or unchilled or sand moulds. The running properties were observed and tests of density, hardness, tensile strength, porosity under hydraulic pressure and electrical conductivity were made. Pouring temperature had little effect, but aluminium, while improving the running properties, lowered the ductility, hardness, tensile strength and electrical conductivity and raised the porosity of the brass. Antimony increased slightly the running and decreased slightly the conductivity, but its other effects were insignificant.

THE DUNDEE MEETING OF THE BRITISH ASSOCIATION

General Arrangements

PREPARATIONS for the Dundee Meeting of the British Association, which will open on August 30, are in their final stage. There are indications that fear for the international situation is keeping a few visiting members away, but powerful efforts are being made in Dundee to secure the support of a strong body of local members such as is always anticipated at a Scottish meeting.

The main outlines of the programme have been announced long ago, and the activities of the sections are given under their own headings, but there are certain new features to be mentioned here. The evening lecture on "Science and Social Pioneering", which Dr. Isaiah Bowman, president of Johns Hopkins University, will deliver, will be the first of a new series furnishing outward evidence of the intimate relations between the British and American Associations, which were so happily strengthened during the meeting at Cambridge last year. This series will be known as the British and American Association Lectures, a title which, if something cumbrous, has at least the merit of self-explanation. A British lecturer will be heard at an American Association meeting next year, and so thereafter, in alternate years at future meetings of the two Associations, this invaluable contact is intended to be maintained.

The new Division for the Social and International Relations of Science, created by the General Committee of the Association last year, seems already to have established itself firmly. In case it should be feared that its potential field is beyond the scope of the Association's work, it may be said at once that there is no evidence of this: the outlook of the Association (taken as a whole) is wide, and its mechanism elastic, and the new Division is in direct line of descent from the intentions of those who founded the Association more than a century ago. It will be evident from the transactions of the Division at Dundee that through it the Association is establishing contacts with other organizations which otherwise might have been neglected. The Division will hold three sessions, at which there are to be discussed an interim report on an inquiry into the organization of research in Britain, in which the Division is associated with P E P (Political and Economic Planning); population problems; international intellectual co-operation, introduced by Prof. Gilbert Murray; and nutrition, introduced by Sir John Orr. The Division has also arranged the Sunday evening lecture requested by the local executive in Dundee, which will be given by Sir Richard Gregory as chairman, on "Contacts of Religion and Science"; the public as well as members of the Association being admitted.

A third unusual feature in the programme of the meeting, though not without precedent, is found in the two special sessions dealing with jute, the material (it need scarcely be said) of one of Dundee's staple industries. Every scientific aspect of this material and the industry associated with it will be dealt with by experts, and the Textile Institute will collaborate in publishing the results.

The familiar programme and daily time-table will appear in a new guise. Its pages are increased to correspond in width (though not in depth) with those of the forthcoming quarterly form in which the annual report will be published in future. Moreover, the *Journal* of sectional transactions, containing abstracts of papers, will appear within the same covers and not as a separate publication, an arrangement, carried out not without heart-searching on the part of the administration, which should make for the general convenience. The new quarterly, of which the first number will appear at the end of October, will bear the title of *The Advancement of Science*, a name hitherto attached to the collection of presidential addresses which has appeared for some years at the time of the meeting. This collection will now be discontinued, but in its place separates of the various addresses will be on sale at the meeting.

Entertainments detailed in the programme, while nowise overwhelming it, fully exemplify Scottish hospitality, notably the generous number of garden parties to be given by private hosts. The Corporation and the University College both entertain, as is customary, as also do the Dundee Harbour Trustees with a river trip. The Eastern Club, the University College Students' Union, the Dundee Rotary Club, the Dundee Medical Club and the Forfarshire Medical Association, the Overseas League, and, it scarcely need be added, several famous golf clubs, including the Royal and Ancient of St. Andrews, all offer hospitality in various forms. Finally, masonic members of the Association will find very special interest in a meeting arranged for them by the Dundee St. Mary Lodge, to exemplify a working of the Scottish Constitution.

The reports of the Council, the Down House Committee, and the Division for the Social and International Relations of Science, which will be presented to the General Committee, cover a range of incidental interests from the safeguarding of native tribes in Australia to that of the green belt around London, and from the possibility of a future annual meeting in Brighton to that of scientific delegations to the West Indies and Southern Rhodesia. It is no matter for wonder that the general treasurer in a recent appeal, and again in his forthcoming report, has asked for extended support for the Association by way of membership "from all those who appreciate the benefits that science confers and wish to aid the Association in discharging its function of the advancement of science".

Sectional Programmes

Section A (Mathematical and Physical Sciences)

SECTION A (Mathematical and Physical Sciences) has for many years had two sub-sections, one for mathematics and the other for cosmic physics, and each of them this year has some interesting discussions to offer. On the Saturday, there will be a discussion on "The Teaching of Mechanics", opened by Prof. E. A. Milne and continued by speakers representing Scottish and English schools and

universities. Although the meeting is not a joint one, it is hoped that the choice of day will permit some members of Section L to attend and to take part in the open discussion. In cosmic physics, a discussion on solar-terrestrial relationships, to be opened by Prof. E. V. Appleton, promises much of interest, as also does one on the surface temperatures of stars.

It is not to be thought that the only matters of interest are those pertaining to the special interests of the subsections (though these are not so specialized as to be unintelligible to the ordinary member), for the main section shows a judicious blend of 'new' and 'classical' (or 'applied') physics, which should interest many. Starting on Thursday with electron optics and the presidential address by Mr. R. S. Whipple on "Instruments in Science and Industry", the former of which is 'electronic physics' but of wide everyday application, the section proceeds on Friday to artificial radioactivity, and on Monday to the theoretical but applied subject of "High-Speed Flight", and thence on Tuesday to high temperature physics, the programme of which is largely devoted to papers from the National Physical Laboratory and from laboratories of the steel-making industry. In the course of this session, a coloured film will be shown to illustrate some of the physical problems of modern steel making.

SECTION B (CHEMISTRY)

THE proceedings of Section B will begin with the presidential address by Prof. E. K. Rideal on "Film Reactions as a New Approach to Biology", and the rest of the day will be devoted to a joint discussion with Section I on "Tissue Respiration", to be opened by Prof. R. A. Peters. Dr. Malcolm Dixon will deal with catalysis in tissue respiration (catatorulin) and Dr. H. Theorell (Stockholm) with the flavoproteins. After an account of cytochrome and similar compounds by Prof. D. Keilin, Dr. F. Dickens will consider the interpretation of intermediary metabolism from measurement of tissue respiration, and Dr. J. H. Quastel that of narcosis. Dr. S. Ochoa will deal with carbon dioxide evolution and cocarboxylase. Prof. H. S. Raper will discuss the control of tissue respiration, and other aspects of the subject will be presented in discussion by Dr. D. E. Green, Sir F. Gowland Hopkins, Dr. H. A. Krebs, Dr. T. Mann and Dr. E. P. Poulton.

A discussion on "Light Alloys" will be opened by Dr. C. H. Desch, who will speak of their growing importance and will refer in particular to their mechanical strength and to their resistance to corrosion. Dr. A. G. C. Gwyer will discuss the constitution of aluminium alloys and Mr. W. C. Devereux will describe the controls of production of light alloys, including spectrographic analysis and the X-ray control of their thermal and mechanical treatment. Their industrial uses will be dealt with by Prof. A. von Zeerleder. An exhibition illustrating the uses of light metals and alloys, with a research section, will be open throughout the meeting.

Progress in physical chemistry is largely dependent on the development of new technique. Not only does such technique help to solve specific problems unassailable by the older methods, but it also opens up entirely new lines of investigation. This topic will form the subject of a discussion in which new methods and their bearing on problems connected with the mechanism of chemical reactions will be described. Radioactive and non-radioactive indicators ('labelled atoms') will be dealt with by Prof. S. Sugden and Prof. W. F. K. Wynne-Jones respectively. Dr. M. Ritchie will discuss reactions of free atoms; Prof. T. Alty accommodation coefficients, and Dr. H. W. Melville will describe recent technique in photochemistry.

At the last Dundee meeting of the British Association in 1912 Prof. A. McKenzie opened a discussion on the migration of groups and dealt especially with the Walden rearrangement. During the quarter of a century which has elapsed, the Dundee school under his leadership has greatly advanced our knowledge in this field. On the present occasion, Prof. McKenzie and Dr. R. Roger will open a discussion on intramolecular change involving the migration of groups, and will give an account of their work on deamination and dehydration involving semi-pinacolinic rearrangements in which optically active alcohols and glycols have been used. Contributions will also be made by Prof. M. Tiffeneau (Paris), Dr. S. F. Birch, who will deal with the catalytic isomerization of paraffins, Dr. A. K. Mills and Dr. T. S. Stevens.

A special feature of the meeting will be a two-day discussion on jute, the principal industry of Dundee, including chemical and physical as well as economic aspects of the subject. In this connexion a comprehensive exhibition will be open throughout the meeting. Two popular lectures will be given. Dr. D. A. Spencer will deal with colour photography and Dr. H. W. Melville will give an experimental lecture on the methods of producing light.

By kind invitation of the University Court, a visit will be made to the University of St. Andrews, and visits to jute-spinning mills and Messrs. Moncrieff's glass works at Perth are being arranged. The usual sectional dinner will be held. The following chemists have accepted the Council's invitation to attend as foreign guests of the Association: Dr. H. Theorell (Stockholm), Prof. Marc Tiffeneau (Paris) and Prof. A. von Zeerleder (Zurich).

SECTION C (GEOLOGY)

THE programme of Section C (Geology) will, for the most part, be devoted to Scottish geology. Prof. H. H. Read has taken as the title of his presidential address "Metamorphism and Igneous Action". He has spent much time in the study of this subject in the Highlands and elsewhere, and this summary of his views will be awaited with interest.

Discussions are to be held on the raised beaches of the Forth and Tay and on the boundary between the Carboniferous and the Old Red Sandstone. These are matters of considerable importance to geologists working in Scotland, and the contributors are largely drawn from the Scottish branch of the Geological Survey.

A number of short individual papers will be presented. These will include: Prof. Innes on the geology of the Dundee district; Dr. J. Pringle on the discovery of Cambrian fossils in the Highland Border Series, an important advance in the study of these rather problematical rocks; Dr. M. Macgregor on the buried channel of the Forth, with Dr. Pringle on the Carboniferous rocks of Bridge of Awe and with Prof. J. Ritchie on remains of reindeer from the glacial deposits of Glasgow; Dr. T. S. Westoll on the fish fauna of the 'Caledonian' Old Red Sandstone; Prof. W. T. Gordon on a new type of seed from the Carboniferous rocks of Tantallon; Dr. E. Dix on the Coal Measures of Warwickshire and with Mr. W. D. Ware, on those of Pembrokeshire;

Dr. A. Lamont on antidunes in geology; Mr. E. H. Davison on the solubility of rocks and Mr. F. W. Anderson on algal limestones in east Fife and on ostracod zones in the Wealden and Purbeck Beds.

Section D (Zoology)

PROF. J. RITCHIE'S presidential address to Section D is entitled "Perspectives in Evolution".

Two discussions have been arranged by the Section. The first of these will cover various aspects of parthenogenesis. Prof. A. Vandel, the distinguished French authority on this subject, will open the discussion, Prof. Peacock will give a review of recent researches in experimental parthenogenesis, and Dr. Sanderson and Miss Malcolm (two workers from Prof. Peacock's laboratory) will contribute papers on the cytological aspects of parthenogenesis in snails and sawflies.

The second discussion will deal with the biology of salmon and trout, and, in the six papers arranged under this heading, a résumé of our present knowledge of the migratory habits, homing instinct, food and sexual phases of these fishes will be given. Mr. Menzies, of the Scotch Fishery Board, will open the session, and other speakers include Prof. Orton, Mr. R. M. Neill and Mr. MacFarlane. Mr. D. F. Leney will contribute an account of modern hatchery methods for salmon and trout.

Dr. Fraser Darling will give a semi-popular lecture on the grey seal in which will be included a summary of his recent researches on the behaviour and habits of the colony of seals on North Rona. Prof. Brambell and Mr. H. A. Cole will describe a new ciliary organ found in enteropneusts which suggests affinities with the hypophysis of higher vertebrates and adds further evidence for the chordate affinities of the Hemichorda. Dr. Worthington will outline the developments in research on fresh waters which have been inaugurated at the Freshwater Biological Station at Wray Castle.

There is to be an exhibition of biological films produced by the Strand Film Zoological Production, Ltd., Gaumont British Instructional Films, Ltd., and Associated British Film Distribution, Ltd. Sectional excursions have been arranged to Glen Doll, the Field Station of the Department of Natural History at University College, Dundee, to the Perth Museum, and to the Silver Fox Farm of Mr. J. B. A. Mackenzie at Balbeggie.

Section E (Geography)

SECTION E (Geography) at Dundee will this year depart from precedent in that it will not open its meetings with the presidential address. Instead the first morning will be given to certain urban studies of Scotland and to a joint discussion with many other sections on the proposed National Atlas. This latter proposal came before the Section at Cambridge and received general support. Since then a representative committee has been at work on the scheme, and its report will form the basis of the discussion. In the afternoon there will be two papers dealing with recent developments in the Ordnance Survey.

On Friday Mr. A. Stevens will deliver his presidential address, there will be one paper by Mr. Linton suggesting a new idea in the evolution of some of the Scottish rivers, and the local secretary, Dr. J. F. Scott, will give a preliminary account of the sectional excursions.

The excursions begin on Friday afternoon with a visit to the city of Dundee and to the Hillbank Linen Works. On the following day the Section will make a circular tour of the Fife peninsula, and on Sunday a visit will be made to part of the Highlands. Another excursion, on Tuesday, will give opportunity to study the agricultural geography of the Carse of Gowrie.

On Monday all papers deal with topics or regions which are outside Great Britain. Prof. T. M. Knox will raise some important points concerning the future of the palm oil industry in West Africa. Dr. N. Friberg, a foreign guest of the Association, will describe highway developments in Sweden. The Spanish zone in Morocco, the great basin of North America, and current movements of population in Eire are the subjects of the remaining papers.

On Tuesday, apart from one paper on the geography of Cheshire at the time of the Domesday Survey, the general topics are more closely related to Dundee or its neighbourhood. Thus one paper deals with population changes in the Lower Tay valley since 1755, and another discusses the geographical background of Scottish sea-borne trade in the eighteenth century. Dr. Snodgrass, whose studies of the agricultural geography of Scotland are well-known, will make comparisons of population density and agricultural type in Britain and the Continent.

The meetings of the Section will end on Wednesday morning with two papers on subjects of physical geography, in one of which Mr. W. V. Lewis will further develop his views on plucking as a factor in glacial valley erosion.

The programme of the Section covers a wide field, and apart from its general interest affords many indications of the way in which geography plays a part in current problems. It is hoped that this side of the Section's activities will make an appeal to those members of the Association who will be naturally interested in the new Division for Social and International Relations of Science.

Section F (Economics)

BY the nature of its subject, the work of Section F (Economics) is essentially concerned with public welfare. It is current events which largely decide the aspects to be discussed. Last year unemployment and the trade cycle occupied the first place. For the Dundee meeting, a number of the papers concern urgent Scottish problems. There are to be papers on housing in Scotland, on the finance of Scottish Local Government, on the finance of new enterprises in Scotland, and on the economy of the crofting districts. Lord Douglas Hamilton will open a special afternoon session on the problem of the distressed areas, and the various measures taken to assist them.

Although the name of Dundee has always been associated with the jute industry, it has been the home of some financial activities of more than local importance. There will be a paper on the Dundee Investment Trusts. Three problems of 'planning' will come up for discussion—the localization of industry, the economics of urban decentralization, and the consequences of the legislation concerning the coal-mining industry. In contrast to these detailed topics, a whole morning will be given up to the discussion of the theory and problems of socialism, in its national and international aspects. It is perhaps a significant sign of the times that the Presidential address by Prof. H. O. Meredith will be on Rates and Taxes.

SECTION G (ENGINEERING)

THE presidential address to the Engineering Section will be delivered by Mr. H. E. Wimperis, who was for many years director of scientific research at the Air Ministry, and has recently been in Australia and New Zealand to advise those Governments upon the establishment of aeronautical research organizations. The subject of his address will be the "Future of Flying". Another item of great aeronautical interest will be a paper to be read by Major R. H. Mayo describing his composite aircraft which is under trial by the Air Ministry and Imperial Airways. The paper will be followed by a discussion which will be opened by a representative of Messrs. Shorts, who have built the trans-Atlantic flying boats, and a representative of Sir Alan Cobham, who has developed a system of flight refuelling.

The Section has during several years given careful consideration to the training of engineers, particularly in university courses. The matter was dealt with last year by Prof. R. V. Southwell in his presidential address and afterwards a questionnaire was circulated to a large number of practising engineers and firms who employ university graduates. A very large number of answers have been received, and these will be shortly reviewed by Prof. Willis Jackson who has been mainly responsible for the work.

An important paper will be read by Prof. R. G. H. Clements on the design of roads. There will be a number of other papers, and the Section will repeat its experiment of last year by including five short papers by junior engineers, each of whom will be allowed thirty minutes for his paper and the discussion which will follow it.

SECTION H (ANTHROPOLOGY)

ACCORDING to custom, the programme has been arranged so that the various branches of the study of man are fairly represented. The section has this year restricted the number of papers to be read, in order that there may be adequate time for discussion. Prof. W. E. Le Gros Clark will give the presidential address (Friday) on "The Scope and Limitations of Physical Anthropology". The Monday morning is devoted to a joint discussion with Section I (Physiology) on "Nutrition and Physique", which should appeal to a wide public. In the afternoon of the same day important communications will be read on "The Affinities of the South African Pleistocene Anthropoids" (Dr. R. Broom) and on "Recent Discoveries bearing on Human History in South Africa" (Prof. Raymond Dart). Dr. Broom has sent a collection of casts which will be exhibited at the meetings. Two papers of philosophical interest will occupy the latter part of the afternoon: "The Evolution of the Human Brain" (Dr. S. Zuckerman) and "Mental Evolution of the Primates" (Dr. R. H. Thouless).

In the periods given to archæology there will be papers on a recent discovery of cult objects at Grimes Graves (Mr. A. L. Armstrong), an Irish hill-site of the Megalithic Period (Dr. E. E. Evans), the types and chronology of beakers in Spain (Dr. Bosch Gimpera), connexions between the Lake District and Ireland in the Bronze Age (Miss C. Fell), and on the prehistory of Uganda (Prof. C. van Riet Low and Mr. E. J. Wayland). Having special reference to Scotland there will be two papers: "Prospects of the Advancement of Knowledge in Early Scottish History" (Dr. A. O. Anderson), and "Some Recent Work of the Royal Commission on Ancient Monuments (Scotland)" (Mr. Angus Graham).

General ethnology is represented by communications dealing with a wooden tea-pot from Tibet (Mr. R. Kerr), racial crossing and cultural efflorescence (Prof. J. Murphy), the crane dance (Prof. P. E. Newberry), sign language and the education of deaf mutes (Sir Richard Paget), spiritual journeys of the seer (Mrs. N. K. Chadwick), change of personal name among the Biblical Hebrews (Prof. A. M. Honeyman), primitive cults in the religion of the Old Testament (Prof. E. O. James), the wares of a Moroccan native doctor (Mr. W. Fogg). A joint discussion with Section L (Education) on anthropology in education has also been arranged.

In the section dealing with the ethnology of the British Isles there are papers on ballads and tunes which travel (Prof. W. J. Entwhistle), the folklore of death cairns (Miss Maire McNeill), the folklore associated with fishing in the north-east of Scotland (Mrs. M. McCleod Banks), the human interest of a highland folk-collection (Miss I. F. Grant), and with a survey of some Scottish folklore and its origins (Rev. Canon J. A. McCulloch). Mrs. Catriona MacKintosh will discuss Hebridean folk-songs, and will sing some of the songs to the accompaniment of the old harp.

SECTION I (PHYSIOLOGY)

ALTHOUGH the Physiological and Biochemical Societies each meets nine times every year, yet Section I (Physiology) of the British Association offers certain facilities to physiologists and to biochemists rarely provided by their own societies. These facilities are prearranged discussions on various topics, contact and joint discussion with members of other sections and the opportunity to give publicity to authoritative views on scientific matters of public interest. This is well exemplified by the programme of Section I for the Dundee meeting.

On the Thursday morning, Sections B and I will both hear Prof. E. K. Rideal give his presidential address to Section B on the importance of surface film phenomena in biology. Thereafter, there will be a joint discussion with Section B for the rest of the day on "Tissue Respiration". The subject will be introduced by Prof. R. A. Peters, who convened the discussion. Nine papers will be given. A feature will be the allocation of time for informal discussion of the subject by recognized authorities who have promised to attend.

On Friday morning, Section I will discuss "The Problem of Pain". Very appropriately they will visit St. Andrews for this purpose, where the memory of Sir James Mackenzie, in his day the outstanding authority on the subject, is still fresh in the minds of local workers. In the afternoon there will be visits to the Mackenzie Institute for Clinical Research and to places of scientific and historical interest in the neighbourhood.

On Monday morning there will be a discussion on "Nutrition and Physique" with Section H (Anthropology). Here it is to be expected that the vexed question of "Nature versus Nurture" will receive much attention.

On the Tuesday morning Prof. D. Burns will deliver his presidential address to Section I. His subject is "The Assessment of Physical Fitness". His communication will be followed by a discussion

on the same topic which will extend into the afternoon.

Both the discussions on the Monday and the Tuesday deal with matters of great importance at the present time. Their scientific interest is equalled only by their practical significance for human welfare. It is to be hoped that many members of the Association, not primarily physiologists, will take the opportunity to be present at these two discussions.

Section J (Psychology)

THE presidential address by Mr. R. J. Bartlett is on measurement in psychology.

Two discussions have been arranged. One is on training the mind. Starting with the old problem of formal training, possible ways of giving a broad and general discipline will be debated. The other discussion has to do with the use of films in propaganda, entertainment films and public taste, their influence on the child, and so on.

The remaining papers cover most of the fields of psychology. Of broad interest are papers on methodology in psychological medicine, the ego in his world, the primitive nature of poetic genius, and the psychology of frustration. Industrial problems dealt with are the selection of skilled engineering workers, the sorting process in laundries, the analysis of skill by motion study, and the everyday work of a vocational adviser; while under mental testing and general experimental psychology come papers on the psychological respectability of physical activity, common sense in music testing, the relations between characteristic interests of schoolboys, the predicting of psychological aptitude in students, experiments on the ultra-perceptive faculty, measures of reliability in group intelligence tests and recent experiments in racial psychology.

Section K (Botany) and Department K* (Forestry)

THE president of Section K (Botany), Prof. D. Thoday, will deal in his presidential address with the "Interpretation of Plant Structure". Captain George I. Campbell, the chairman of K*, will speak on "Forestry in Scotland".

The semi-popular lecture, to be given by Sir Frank Stockdale, will deal with "The Application of Economic Botany in the Tropics". Department K* has organized a special meeting on the larch, and a joint meeting of Section K and Department K* will be concerned with local races of trees, seed provenance, and allied topics. The last Tuesday afternoon of the meeting will be given up to the demonstration of exhibits, and the proceedings on that afternoon will finish with the showing of a film, "Coloured Impressions of Tweeddale and the Borders" by Miss I. M. Hayward.

In addition to these special items, Section K and Department K* will have before them a comprehensive programme ranging over many aspects of botany and forestry, including a number of communications from Scottish workers. The serious labours of the meeting rooms will be varied by excursions to places of interest to botanists and foresters, the chief excursions taking place during the week-end.

Section L (Educational Science)

FOLLOWING customary practice in recent years the papers to be read before Section L (Educational Science) are grouped around one main theme with two subsidiary themes. The main subject at the Dundee Meetings will be "Education in and for Industry" which will be discussed on the mornings of Thursday, Friday and Monday. Papers will also be read on Monday on recent educational research in Scotland, while on Tuesday there will be a symposium on the Spens Report.

The President of the Section for 1939 is Dr. A. P. M. Fleming, director of research and training to Metropolitan Vickers Co., and it is fitting in view of the paramount importance that his firm attaches to research and training that his presidential address on Thursday will be on the subject of education for industry. Following the address, papers on aspects of the same theme will be read by Mr. Lester Smith, Dr. Fisher and Mr. Mouat Jones, who will respectively analyse the part played by local education authorities, public schools and universities in educating those who enter industry at various age-ranges and in various capacities. On Friday, papers will be read on education in industry by Mr. Longmuir of Messrs. Mavor and Coulson, and Mr. Darbyshire of the L.M.S., who will describe schemes of training carried out by industrial firms. The contribution made by technical colleges will be discussed by Mr. C. F. Richardson and Principal Smail of the Heriot-Watt College. Post-advanced courses at the universities will be described by Dr. Willis Jackson.

At Monday's meetings papers will be read on aspects of industrial education by Mr. Herbert and Dr. Radley who are the chief research officials at the L.M.S. and the G.P.O. respectively. Educational research in Scotland will be discussed by Prof. McClelland and Mr. Hepburn on the same day. Papers on the Spens Report will be read on Tuesday morning by Miss L. Grier, Mr. Henshall, and Mr. J. B. Frizell.

During the meetings the reports of two research committees will be presented (*a*) on the organization of educational research (Friday), (*b*) on the informative content of education (Monday). Visits will be paid on Monday to Perth Academy and on Tuesday to the Dundee Child Guidance Clinic.

Section M (Agriculture)

THE whole of the programme of Section M (Agriculture) has been designed to be of immediate practical interest to the farmer, and in all of the discussions which have been arranged, a balance has been kept between recent scientific work and its application in practice. Sir Thomas Middleton will open the proceedings on Thursday with his address entitled "Practice with Science" which will be the keynote for all that follows. Other papers on that morning are "The Breeding and Feeding of Beef Cattle" by Mr. Howie, "Sprouted Fodder in Cattle Feeding" by Principal Paterson, and "Pre-digestion of Coarse Fodders" by Mr. Godden.

Friday morning will be devoted to a discussion on agricultural education to be opened by Mr. MacGregor, who will give an account of some Fife experiments in agricultural education. Mr. Wannop will deal with the organization and working of young farmers' clubs, and Prof. Comber will speak on advisory work in relation to agricultural education and research.

A subject of immediate practical application, namely, grass conservation, will be discussed on Monday morning. This will be opened by Mr. Martin Jones, who will deal with "The Place of Grassland in Modern Food Production". He will be followed by Dr. Watson, Mr. Roberts and Prof. Kerr, who will speak respectively on the scientific, economic and engineering aspects of grass conservation.

A subject suited to the locality is that of seed potato growing. A discussion on this will be opened by Mr. Wedderspoon, who will speak as a grower. Virus diseases and seed potatoes will be considered by Dr. Cockerham, and Dr. McIntosh will deal with the importance of variety in potato production.

An innovation this year is the display of a series of agricultural films by Mr. More and Dr. Gordon of the Department of Agriculture of the University of Edinburgh. These will be shown on the Monday afternoon.

THE INSTITUTE OF MEDICAL AND VETERINARY SCIENCE, ADELAIDE

OPENING OF NEW LABORATORIES

BY SIR CHARLES MARTIN, C.M.G., F.R.S.

THE new Institute of Medical and Veterinary Science was officially opened on May 24 by Sir George Murray, Lieutenant-Governor of South Australia and Chancellor of the University of Adelaide. It represents in part an extension and modification of the pre-existing facilities for the study of pathology, bacteriology and biochemistry at the Adelaide Hospital, which is the School of Medicine of the University; in part, it is a new development:

(1) To carry out, with more adequate accommodation, equipment and staff than heretofore, the routine investigations in the subjects mentioned above for the Adelaide Hospital, Stock and Brands Department, country hospitals and private practitioners.

(2) To engage in research into the causation, diagnosis and cure of disease in man and animals.

(3) By bringing into a building devoted to these purposes the University teaching departments of pathology, bacteriology and applied physiology, as well as a properly equipped clinical lecture theatre previously wanting in Adelaide, to attempt to inculcate in the medical students that appreciation of the significance of laboratory medicine to which at present comparatively little attention is paid, and thus to render their later outlook more truly scientific.

The Institute will work in the closest collaboration with the Adelaide Hospital on one hand and with the University on the other, and adds greatly to the amenities of the Adelaide Medical School.

The Institute is the result of a joint effort on the part of the University and members of the staff of the Hospital to bring together in closer association the Department of Pathology of the University and the pathological services of the Hospital. As the two institutions adjoin there were no topographical reasons why this should not be brought about. The Institute is located in the grounds of the Hospital. It faces Frome Avenue, on the opposite side of which is the University campus. It extends backwards amidst the hospital buildings, which are arranged on the pavilion system. It is, therefore, suitably placed for service to the Hospital and readily accessible to patients. It is also close to the other scientific institutes of the University and to the University library. The style is Georgian, with a pleasing simple frontage, and it has been judiciously planned so as to permit of future extension.

In 1936 the authorities were fortunate in securing Dr. E. Weston Hurst for its first director. Shortly afterwards, the University appointed Dr. Hurst to a research professorship which whilst it gives him the status of a senior officer in the University makes no demands upon the director for teaching duties.

Building was not commenced until 1937, so that the details of planning and equipment were able to be made under his supervision, and it is clear from the description of the arrangement of the Institute that they have been admirably conceived and carried out. Facilities for research have had due consideration.

The Institute has two stories with a half-basement. It contains some twenty laboratories, a library, two classrooms, a lecture theatre, a complete operating suite for animals, common rooms for staff and students, offices for the director, and an abundant supply of general service rooms (hot room, cold room, photographic suite, etc.), plenty of store rooms and a workshop.

On the first floor is a museum, 80 ft. × 40 ft., to house the collection of specimens of morbid anatomy hitherto inadequately accommodated at the University. Perhaps the most notable feature of the Institute is its fine animal house. This is situated 100 yards from the main building. Especial care has evidently been devoted to its construction and equipment for the breeding of experimental animals and the convenience and accuracy of experimental work. Expense has not been spared for this essential part of an institute for research in pathology, and it cost one tenth as much as the main building.

The total cost has been £53,000. £15,000 was contributed by three notable benefactions, £10,000 by the commissioners of charitable funds and the rest by the Government of South Australia.

The Institute is governed by a council of six representing the Adelaide Hospital, the University and the veterinary interests of the State.

The Adelaide Hospital being a Government institution, the surrender of a measure of its sovereignty and some of its territory required a special Act of Parliament. By this Act, the Government undertakes to contribute £10,000 a year towards the maintenance of the Institute, the remainder being derived from the University Chest and by the allocation of certain

trust funds at the disposal of the University. As is usual, the provision of a sufficient revenue is left to luck. If the amount of research is to be enough to justify the accommodation, much more than is at present forthcoming will be required to provide modest salaries for the upkeep of research workers. There is no lack of suitable graduates in Australia who are anxious to devote themselves to investigation if they can see a reasonable prospect of a living wage. At present they come to Great Britain with Rhodes and Beit and other research studentships and when trained remain, as there are not openings for them in their mother country. This drainage is not too good for Australia.

Both University and Hospital are to be congratulated on having secured convenient modern accommodation and equipment for teaching and research in pathology and for the better treatment of patients and investigation of their diseases. They are still more to be congratulated on having surmounted the difficulties always attending combined action by the two corporate bodies under separate governance.

Close association of pathology with clinical medicine is desirable. A pathological institute can function apart from a hospital, but its scope is restricted, and researches tend to become remote from the immediate problems of human medicine and the workers lack the stimulus to effort which is afforded by contact with the sick.

An unusual feature in the new Institute at Adelaide is the inclusion of the study of animal pathology as one of its main objects. For some years investigations of diseases of farm animals have been carried on at the pathological laboratory at the Adelaide Hospital, the Government providing a veterinary officer and technical staff for the purpose. The continuation of this association of the study of human and animal diseases will be both convenient and advantageous, for pathology has no specific boundaries, and have not most of the recent discoveries in human pathology been, perforce, achieved by experimenting with animals?

SYNTHETIC SOUND

IN *Philips Technical Review* of June, which is edited by the Research Laboratory of Philips Glow Lamp Factory, Eindhoven, Holland, there is an interesting paper on "Synthetic Sound" by J. F. Schouten. A sound of prescribed character of periodic vibrations, in other words, a sound consisting of harmonic components of prescribed amplitude and phase, is obtained synthetically. This method permits a closer study of a number of problems which are connected with the nature of the perception of sound. The principle used is to make a beam of light vary as a function of the time in the desired wave form. The beam is incident on a photo-electric cell and actuates a loud-speaker. A paper stencil is made and is uniformly illuminated by a point source of light from a tungsten arc lamp placed at a considerable distance away. Behind the stencil there is a rotating aluminium disk in which nine slits have been made, each with a width of 1 mm. and at distances of 40° from each other. Behind the disk, which is driven by a motor, is a lens which focuses the light source upon the photo-electric cell. The only light which can fall upon the photo-electric cell is that which has passed through the part of the stencil cut away and one of the slits. When the disk is turning, the amount of light transmitted at each moment is proportional to the height of the part cut away at the point behind which there is a slit at that moment.

The centre of the wave form is situated on the extension of the axle of the motor. With the arrangement used negative values of the light transmissibility cannot be produced, and so a constant quantity equal to the largest negative value occurring is added to all the ordinates of the wave form to be reproduced. The frequency was determined by regulating the number of revolutions per minute of the motor. If the desired form is given as the sum of a number of sine-shaped components, the components can be added and the resultant wave form cut out. It is easy to cut out the forms separately one above the other.

An attractive property of this apparatus is that it makes it possible to study directly the influence exerted on sound perception by changes in the wave form. For example, when several components have been cut out one above the other, any one of these components can be made to disappear, simply by screening this part of the stencil from the light.

According to a law of acoustics which was formulated by Ohm, a definite pure tone will be observed in a synthetic sound, when a component of the frequency in question occurs in the Fourier analysis of the wave form. According to a rule enunciated by Helmholtz, the sound perception will further depend entirely on the relative intensity with which the different components occur and will be independent of the relative phase of these components.

The author accounts for these facts in a simple way, which seems to be permissible anatomically, that there are in the ear a large number of resonators tuned for different frequencies. This mechanism explains in the first place the fact that the ear carries out, as it were, a Fourier analysis of the sound while it furthermore makes it possible to suppose that the stimuli which are sent from each resonator to the brain depend exclusively upon the intensity, and not upon the phase of the component in question. The author shows how to test this rule by his apparatus.

Four wave forms were built up of very different shape but all having the same harmonics from 1 to 20. It was found that these four totally different wave forms were quite indistinguishable as to their sound impression. It is also stated that non-linear distortion occurs in the ear. This is manifested by the fact that when a pure tone of sufficient intensity is heard, higher harmonics are formed in the ear; when two tones of different frequency are heard at the same time, new tones are formed with frequencies which are linear combinations of the two tones heard (combination tones). The most obvious combination tone is the difference tone and this is the one that was first discovered.

FORTHCOMING EVENTS

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (DUNDEE MEETING).

Wednesday, August 30

At 8.30 p.m.—Sir Albert Seward, F.R.S.: "The Western Isles through the Mists of Ages" (Presidential Address).

Thursday, August 31

At 10 a.m.—Prof. E. K. Rideal, F.R.S.: "Film Reactions as a New Approach to Biology" (Presidential Address: Section B).

Prof. J. Ritchie: "Perspectives in Evolution" (Presidential Address: Section D).

H. E. Wimperis: "The Future of Flying" (Presidential Address: Section G).

A. Mackay, Dr. W. B. Inglis, A. Cavalcanti, Oliver Bell, R. Ford, W. Farr: Session on Films (Section J).

Dr. A. P. M. Fleming: "Education for Industry" (Presidential Address: Section L).

Sir Thomas Middleton: "Practice with Science: the Farmer's Position and the Scientific Worker's Programme" (Presidential Address: Section M).

At 10.30 a.m.—Dr. S. E. Wilson, Dr. M. L. Anderson, J. A. B. Macdonald, J. M. Murray, F. Story: "Larches" (Discussion: Section K*).

At 11 a.m.—W. O. Lester Smith, Dr. K. Fisher, B. Mouat Jones, Dr. J. A. Bowie: "Education as a Preparation for Industry" (Discussion: Section L).

At 11.30 a.m.—R. S. Whipple: "Instruments in Science and Industry" (Presidential Address: Section A).

Prof. R. A. Peters, F.R.S., Dr. M. Dixon, Dr. H. Theorell, Dr. D. E. Green, Sir F. Gowland Hopkins: "Tissue Respiration" (Discussion: Sections B and I).

Prof. E. G. R. Taylor: "The Proposed National Atlas" (Joint Discussion: Sections C, D, E, F, H, K, M).

At 2 p.m.—W. R. Day: "Larches" (Discussion continued: Section K*).

At 2.15 p.m.—Prof. D. Keilin, F.R.S., Dr. F. Dickens, Dr. H. A. Krebs, Dr. T. Mann, Dr. J. H. Quastel, Dr. S. Ochoa, Prof. H. S. Raper, F.R.S., Dr. E. P. Poulton: "Tissue Respiration" (Joint Discussion, continued: Sections B and I).

Prof. A. Vandel, Dr. A. P. Sanderson, Miss M. C. Malcolm, Prof. A. D. Peacock: "Aspects of Parthenogenesis" (Discussion: Section D).

At 2.30 p.m.—(*a*) Dr. J. S. Huxley: Interim report on inquiry into organization of research in Britain; (*b*) A. M. Carr-Saunders: "Population Problems" (Division for Social and International Relations of Science).

Friday, September 1

At 10 a.m.—Dr. J. Lawrence, Dr. W. B. Lewis, Dr. L. H. Gray and Dr. J. Read: "Artificial Radioactivity and its Applications" (Discussion: Section A).

Dr. H. W. Melville, Prof. S. Sugden, F.R.S., Prof. W. F. K. Wynne-Jones, Dr. M. Ritchie, Prof. T. Alty: "New Technique in Physical Chemistry" (Discussion: Section B).

W. J. M. Menzies, P. R. C. Macfarlane, Dr. K. Carpenter, R. M. Neill, Prof. J. H. Orton and J. W. Jones, D. F. Leney: "The Habits of Salmon and Trout" (Discussion: Section D).

Prof. W. E. Le Gros Clark, F.R.S.: "The Scope and Limitations of Physical Anthropology" (Presidential Address: Section H).

R. J. Bartlett: "Measurement in Psychology" (Presidential Address: Section J).

Prof. D. Thoday: "Interpretation of Plant Structure" (Presidential Address: Section K).

J. B. Longmuir, G. L. Darbyshire, F. T. Chapman, Principal J. Cameron Smail, Prof. W. Jackson, C. A. Oakley: "Education in Industry" (Discussion: Section L).

G. MacGregor, A. R. Wannop and Prof. N. M. Comber: "Agricultural Education" (Section M).

S. G. Barker, W. G. Macmillan, H. L. Parsons, D. Carter, H. A. Elkin, Col. J. C. Brockbank, H. C. Bryson, D. A. Oury: Special Session on Jute.

At 10.40 a.m.—Prof. D. Waterston, Prof. J. Morley, Prof. B. A. McSwiney and Dr. B. M. Unkauf, Prof. J. C. Moir, Prof. E. D. Adrian, F.R.S., T. F. Todd: "The Problem of Pain" (Discussion: Section I).

At 11 a.m.—A. Stevens: Presidential Address (Section E).

At 11.15 a.m.—Dr. J. B. Simpson, Dr. E. M. Anderson, Dr. M. Macgregor, Dr. R. Campbell, C. F. Davidson, F. W. Anderson: "The Raised Beaches of the Forth and Tay" (Discussion: Section C).

At 2.15 p.m.—Exhibition of Biological Films in the 'Cinerama' Picture House (Section D).

Conference of Delegates of Corresponding Societies. Prof. H. L. Hawkins, F.R.S.: President.

At 5 p.m.—Sir Frank Stockdale: "The Application of Economic Botany in the Tropics".

Saturday, September 2

At 10 a.m.—Prof. E. A. Milne, F.R.S., Dr. G. P. Tarrant, K. Snell, Prof. R. Peierls: "The Teaching of Mechanics" (Discussion: Section A*).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

INSPECTOR FOR LIVESTOCK DUTIES (unestablished)—The Secretary, Establishment Branch, Department of Agriculture for Scotland, 29 St. Andrew Square, Edinburgh 2 (September 2).

INSTRUCTOR IN ELECTRICAL ENGINEERING AND AN INSTRUCTOR IN MECHANICAL ENGINEERING at the Constantine Technical College, Middlesbrough—The Director of Education, Education Offices, Woodlands Road, Middlesbrough (September 4).

A SCIENTIFIC OFFICER (ENGINEER) at the Road Research Laboratory, Harmondsworth—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (quoting J.39/10) (September 5).

ASSISTANT DRAINAGE ENGINEERS (temporary) in connexion with Land Drainage schemes—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (September 8).

SCIENTIFIC OFFICERS (Ref. No. B.3430) in the Air Ministry Scientific Research Pool, and ASSISTANTS GRADE II (Ref. No. B.3440)—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (September 8).

A RESEARCH PHYSICIST for the Department of Glass Technology—The Registrar, University, Sheffield (September 9).

A STATISTICAL OFFICER at the General Register Office—The Registrar-General, Somerset House, W.C.2 (September 25).

METEOROLOGICAL OFFICER CADETS in the Department of Industry and Commerce—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (September 28).

PROFESSIONAL OFFICER (FIELD HUSBANDRY) in the Department of Agriculture and Forestry of the Union of South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (September 30).

LECTURER IN AGRICULTURAL CHEMISTRY in the University of Sydney—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, W.C.1 (October 15).

A COTTON BOTANIST—The Secretary, Indian Central Cotton Committee, Vulcan House, Nicol Road, Fort, Bombay (October 20).

CIVILIAN EDUCATION OFFICERS, Grade III, in the R.A.F. Educational Service—The Under-Secretary of State, Air Ministry (E.S.I.) (E.M.P.A.) Adastral House, Kingsway, W.C.2.

ASSISTANTS (Grade III) in Research Departments—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (quoting A/139).

ASSISTANT ADVISORY OFFICER to the Board of Greenkeeping Research—The Director, St. Ives Research Station, Bingley, Yorks.

RECENT SCIENTIFIC AND TECHNICAL BOOKS

Volumes marked with an asterisk (*) have been received at "NATURE" Office

Mathematics : Mechanics : Physics

Armitage, E. Higher School Certificate Practical Physics. Cr. 8vo. Pp. xx +239. (London : John Murray, 1939.) 6*s.**

Ball, W. W. Rouse. Mathematical Recreations and Essays. Eleventh edition, revised by H. S. M. Coxeter. Ex. Cr. 8vo. Pp. xvi +418. (London : Macmillan and Co., Ltd., 1939.) 10*s.* 6*d.* net.*

Durell, Clement V. Exercise and Theorems in Geometry. An Alternative Arrangement of the Material contained in "A New Geometry for Schools", Stage A and Stage B. Cr. 8vo. Pp. xvi +568 +xxii. (London : G. Bell and Sons, Ltd., 1939.) 5*s.* 6*d.*

Einstein, Albert, and Infeld, Leopold. The Evolution of Physics. Cr. 8vo. Pp. x +320. (London : The Scientific Book Club, 1939.) 2*s.* 6*d.**

Faraday Society. Luminescence : a General Discussion held by the Faraday Society, September 1938. Roy. 8vo. Pp. 240. (London and Edinburgh : Gurney and Jackson, 1939.) 12*s.* 6*d.**

Fricke, Hermann. Weltätherforschung : ein Aufbauprogramm nach dem Umsturz in der Physik. Med. 8vo. Pp. 140. (Weimar : Rudolf Borkmann K.-G., 1939.) 4.50 gold marks.*

l'Institut Henri Poincaré, Annales de. Vol. 8, Fascicule 1 : Recherches sur l'équilibre economique, par Jean Ullmo ; Le moment magnétique du neutron, par Félix Bloch. Imp. 8vo. Pp. 78. Vol. 8, Fascicule 2 : Optique cristalline (lumière et rayons X) ; interaction des atomes par rayonnement. Par P. P. Ewald. Imp. 8vo. Pp. 79–110. Vol. 8, Fascicule 3 : Les transformations de Fourier, Laplace, Gauss, et leurs applications au calcul des probabilités et à la statistique. Par F. Tricomi. Imp. 8vo. Pp. 111–150. Vol. 8, Fascicule 4 : Qu'apprend-on de l'intérieur du globe par les mesures faites à la surface ? Pesanteur, magnétisme. Par Marcel Brillouin. Imp. 8vo. Pp. 151–192. (Paris : Institut Henri Poincaré ; Gauthier-Villars, 1938.)*

Ives, Howard Chapin. Seven Place Natural Trigonometrical Functions. 18mo. Pp. 222. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1939.) 12*s.* 6*d.* net.

Joos, Georg. Lehrbuch der theoretischen Physik. Dritte Auflage. Roy. 8vo. Pp. xviii +704. (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1939.) 24 gold marks.*

Larcombe, H. J. New Arithmetics for Senior Schools. Cr. 8vo. Book 1 : Ages 11–12. Pp. 48. 6*d.* Teacher's Book 1. Pp. 56. 1*s.* Book 2 : Ages 12–13. Pp. 48. 6*d.* Teacher's Book 2. Pp. 36. 1*s.* Book 3 : Ages 13–14. Pp. 48. 6*d.* Teacher's Book 3. Pp. 36. 1*s.* Book 4 : Ages 14–15. Pp. 64. 7*d.* Teacher's Book 4. Pp. 44. 1*s.* (London : Macmillan and Co., Ltd., 1939.)

Larcombe, H. J. New Mental Arithmetics. Demy long 12mo. Third Year Junior : 9 to 10 Years. Pp. 64. 7*d.* Third Year Junior, Teacher's Book. Pp. 20. 8*d.* Fourth Year Junior : 10 to 11 Years. Pp. 64. 7*d.* Fourth Year Junior, Teacher's Book. Pp. 20. 8*d.* First Year Senior : 11 to 12 Years. Pp. 64. 7*d.* First Year Senior, Teacher's Book. Pp. 20. 8*d.* Second Year Senior : 12 to 13 years. Pp. 64. 7*d.* Second Year Senior, Teacher's Book. Pp. 20. 8*d.* Third Year Senior : 13 to 14 Years. Pp. 64. 7*d.* Third Year Senior, Teacher's Book. Pp. 20. 8*d.* (London : Macmillan and Co., Ltd., 1939.)

Luckiesh, Matthew. Colour and Colours. Med. 8vo. Pp. x +206. (London : Chapman and Hall, Ltd., 1939.) 15*s.* net.*

Malengreau, Julien. Notice sur les fondements de la géométrie. Demy 8vo. Pp. 45. (Bruxelles : A. de Boeck, 1939.)*

Perron, O. Irrationalzahlen. (Göschens Lehrbücherei, Band 1.) Zweite durchgesehene Auflage. Roy. 8vo. Pp. 199. (Berlin : Walter de Gruyter und Co., 1939.) 9.80 gold marks.

Raaz, Franz, und **Tertsch, Hermann.** Geometrische Kristallographie und Kristalloptik und deren Arbeitsmethoden : eine Einführung. Med. 8vo. Pp. ix +215. (Wien und Berlin : Julius Springer, 1939.) 18.60 gold marks.*

Shively, Levi S. An Introduction to Modern Geometry. Demy 8vo. Pp. xi +167. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1939.) 10*s.* net.*

Siddons, A. W., and Snell, K. S. Introduction to Geometry. Cr. 8vo. Pp. viii +166. (Cambridge : At the University Press, 1939.) 2*s.* 3*d.*

Thiel, A. Absolutkolorimetrie. (Arbeitsmethoden der modernen Naturwissenschaften.) Imp. 16mo. Pp. xv + 215. (Berlin : Walter de Gruyter und Co., 1939.) 10.80 gold marks.*

Ville, Jean. Étude critique de la notion de collectif. (Monographies des probabilités, Fascicule 3.) Roy. 8vo. Pp. iv +144. (Paris : Gauthier-Villars, 1939.) 75 francs.*

Waerden, B. L. van der. Einführung in die algebraische Geometrie. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen, Band 51.) Roy. 8vo. Pp. 247. (Berlin : Julius Springer, 1939.) 18 gold marks.

Weiss, E. A. Punktreihengeometrie. Roy. 8vo. Pp. 232. (Leipzig und Berlin : B. G. Teubner, 1939.) 14 gold marks.

Wilson, A. H. Semi-Conductors and Metals : an Introduction to the Electron Theory of Metals. (Cambridge Physical Tracts.) Demy 8vo. Pp. x +120. (Cambridge : At the University Press, 1939.) 7*s.* 6*d.* net.*

Chemistry : Chemical Industry

Bergell, C., u.a., Bearbeitet von. Seifen und seifenartige Stoffe. (Chemie und Technologie der Fette und Fettprodukte, Band 4.) Roy. 8vo. Pp. 610. (Wien und Berlin : Julius Springer, 1939.) 93 gold marks.

Bottger, W., Herausgegeben von. Physikalische Methoden der analytischen Chemie. Teil 3 : Chromatographie, Verdampfungsanalyse, Spektroskopie, Konduktometrie, Photoelektrometrie, Polarographie, Potentiometrie. Roy. 8vo. Pp. xx +836. (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1939.) 65 gold marks.*

Brodshaug, M., and Brewer, W. L. Electrochemistry. Cr. 8vo. Pp. iv +26. (Chicago : University of Chicago Press ; London : Cambridge University Press, 1939.) 9*d.* net.

Brodshaug, M., and Fraser, J. A. Colloids. Cr. 8vo. Pp. iv +30. (Chicago : University of Chicago Press ; London : Cambridge University Press, 1939.) 9*d.* net.

Conant, James Bryant. The Chemistry of Organic Compounds : a Year's Course in Organic Chemistry. Revised with the assistance of Max Tishler. Demy 8vo. Pp. x +658. (New York : The Macmillan Company, 1939.) 18*s.* net.*

Conway, Edward J. Micro-Diffusion Analysis and Volumetric Error. Roy. 8vo. Pp. xiii +306. (London : Crosby Lockwood and Son, Ltd., 1939.) 25*s.* net.*

Evans, U. R. Korrosion, Passivität und Oberflächenschutz von Metallen. Übersetzung von E. Pietsch. Sup. Roy. 8vo. Pp. 742. (Berlin : Julius Springer, 1939.) 54 gold marks.

Fales, Harold A., and Kenny, Frederic. Inorganic Quantitative Analysis. New edition. 8vo. Pp. 713. (New York and London : D. Appleton-Century Co., Inc., 1939.) 12*s.* 6*d.* net.

Grün, R. Chemie für Bauingenieure und Architekten. Roy. 8vo. Pp. 144. (Berlin: Julius Springer, 1939.) 9.60 gold marks.

Houben, J., Herausgegeben von. Fortschritte der Heilstoffchemie. Abteilung 2, Band 3: Die heterocyklischen Verbindungen mit Ring-Sauerstoff- und 1 oder 2 Ring-Stickstoff-Atomen. Sup. Roy. 8vo. Pp. 1361. (Berlin: Walter de Gruyter und Co., 1939.) 230 gold marks.

Organic Syntheses: an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. John R. Johnson, Editor-in-Chief. Vol. 19. Med. 8vo. Pp. v+105. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 8*s.* 6*d.* net.*

Pauling, Linus. The Nature of the Chemical Bond and the Structure of Molecules and Crystals: an Introduction to Modern Structural Chemistry. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University.) Med. 8vo. Pp. xiv+429. (Ithaca, N.Y.: Cornell University Press; London: Oxford University Press, 1939.) 21*s.* net.*

Röder, Hugo Levin. Rheology of Suspensions: a Study of Dilatancy and Thixotropy. Sup. Roy. 8vo. Pp. xiv+86. (Amsterdam: H. J. Paris, 1939.)*

Zechmeister, L., Herausgegeben von. Fortschritte der Chemie organischer Naturstoffe: eine Sammlung von zusammenfassenden Berichten. Band 2. Roy. 8vo. Pp. vii+366. (Wien und Berlin: Julius Springer, 1939.) 28 gold marks.*

General Biology: Natural History
Botany: Zoology

Allen, Glover Morrill. Bats. Med. 8vo. Pp. x+368+31 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1939.) 17*s.* net.*

Beutner, R. Life's Beginning on the Earth. Med. 8vo. Pp. x+222. (London: Chapman and Hall, Ltd., 1939.) 12*s.* 6*d.* net.*

Bibby, H. C. Heredity, Eugenics and Social Progress. (New People's Library, Vol. 25.) Gl. 8vo. Pp. 94. (London: Victor Gollancz, Ltd., 1939.) Paper, 1*s.*; cloth, 1*s.* 6*d.*

Bristowe, William Syer. The Comity of Spiders. Vol. 1. (Ray Society, Vol. 126, for the Year 1938.) Demy 8vo. Pp. x+228+19 plates. (London: Bernard Quaritch, Ltd., 1939.) 25*s.*

Brown, Leslie. Outlaw of the Air. Ex. Cr. 8vo. Pp. x+246+8 plates. (London: Geoffrey Bles, 1939.) 8*s.* 6*d.* net.*

Burbank, Luther. An Architect of Nature: being the Autobiography of Luther Burbank. With Biographical Sketch by Wilbur Hall. (Thinker's Library, No. 76.) Fcap. 8vo. Pp. xvii+139. (London: Watts and Co., 1939.) 1*s.* net.*

Burr, Malcolm. The Insect Legion. Demy 8vo. Pp. xiv+321+16 plates. (London: James Nisbet and Co., Ltd., 1939.) 12*s.* 6*d.* net.*

Chibnall, Albert Charles. Protein Metabolism in the Plant. (Yale University: Mrs. Hepsa Ely Silliman Memorial Lectures.) Med. 8vo. Pp. xv+306+3 plates. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1939.) 18*s.* net.*

Curtis's Botanical Magazine. Edited by Sir Arthur William Hill. (Published for the Royal Horticultural Society, London.) Vol. 162, Part 1. Roy. 8vo. Pp. 32+plates 9557–9567. (London: Bernard Quaritch, Ltd., 1939.) 17*s.* 6*d.* net.*

Darling, F. Fraser. A Naturalist on Rona: Essays of a Biologist in Isolation. Demy 8vo. Pp. x+138+28 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 7*s.* 6*d.* net.*

Duncan, Carl D., and Pickwell, Gayle. The World of Insects. Med. 8vo. Pp. ix+409. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 21*s.*

Eales, N. B. The Littoral Fauna of Great Britain: a Handbook for Collectors. Demy 8vo. Pp. xvii+302+25 plates. (Cambridge: At the University Press, 1939.) 12*s.* 6*d.* net.*

Fishery Board for Scotland. Scientific Investigations, 1939, No. 1: Age and Growth of Lemon Soles in Scottish Waters. By Bennet B. Roe. Imp. 8vo. Pp. 39+1 plate. (Edinburgh and London: H.M. Stationery Office, 1939.) 1*s.* 6*d.* net.*

Gurney, Robert. Bibliography of the Larvae of Decapod Crustacea. (Ray Society, Vol. 125, for the Year 1937.) Demy 8vo. Pp. vii+123. (London: Bernard Quaritch, Ltd., 1939.) 12*s.* 6*d.*

Herms, William B. Medical Entomology: with Special Reference to the Health and Well-Being of Man and Animals. Third edition, based on the book known as "Medical and Veterinary Entomology". Roy. 8vo. Pp. xx+582. (New York: The Macmillan Company, 1939.) 24*s.* net.*

Hirsch, Gottwalt Christian. Form- und Stoffwechsel der Golgi-Körper. (Protoplasma-Monographien, Band 18.) Demy 8vo. Pp. xi+394. (Berlin: Gebrüder Borntraeger, 1939.) 28 gold marks.*

Holman, Richard M., and Robbins, W. W. A Textbook of General Botany: for Colleges and Universities. Fourth edition, revised. Med. 8vo. Pp. xviii+664. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 20*s.* net.

Hooper, M. M. Common Sense Beekeeping. Cr. 8vo. Pp. 96. (London: Link House Publications, Ltd., 1939.) 2*s.* 6*d.* net.*

Kuckuck, Hermann. Pflanzenzüchtung. (Sammlung Göschen, Band 1134.) Pott 8vo. Pp. 125. (Berlin: Walter de Gruyter und Co., 1939.) 1.62 gold marks.*

Lüdi, Werner. Die Geschichte der Moore des Sihltales bei Einsiedeln. (Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich, Heft 15.) Med. 8vo. Pp. 95+9 plates. (Bern: Hans Huber, 1939.) 4.50 gold marks; 7.50 Schw. francs.*

Mangham, Sydney. Earth's Green Mantle: Plant Science for the General Reader. Ex. Cr. 8vo. Pp. 322+41 plates. (London: English Universities Press, Ltd., 1939.) 10*s.* 6*d.* net.*

Martin, Rev. W. Keble, and Fraser, Gordon T., Edited by; with the assistance of **Stephenson, Rev. Thomas, and Day, Francis M.** Flora of Devon: Phanerogams, Vascular Cryptogams, Charophyta. Promoted by the Devonshire Association. Demy 8vo. Pp. xv+787+8 plates. (Arbroath: T. Buncle and Co.; London: Wheldon and Wesley, Ltd., 1939.) 25*s.*

Medsger, Oliver Perry. Edible Wild Plants. Ex. Cr. 8vo. Pp. xvi+323+16 plates. (New York: The Macmillan Company, 1939.) 16*s.* net.*

Ministry of Agriculture and Fisheries. Fishery Investigations, Series 2, Vol. 16, No. 4: Further Experiments in the Breeding of Oysters (*Ostrea edulis*) in Tanks. By H. A. Cole. Imp. 8vo. Pp. 51+5 plates. (London: H.M. Stationery Office, 1939.) 2*s.* net.*

Nice, Margaret Morse. The Watcher at the Nest. Demy 8vo. Pp. viii+160. (New York: The Macmillan Company, 1939.) 8*s.* 6*d.* net.

Peacock, A. D., and Garry, R. C. Living and Learning: an Introduction to Plant, Animal and Human Biology. Cr. 8vo. Pp. 215. (London: Edward Arnold and Co., 1939.) 2*s.* 6*d.*

Rice, Thurman B. A Textbook of Applied Microbiology and Pathology. Second edition of "Applied Bacteriology". Demy 8vo. Pp. viii+271. (New York: The Macmillan Company, 1939.) 11*s.* net.

Robertson, A. W. P., and Powell, R. D. Bird Watching Days. Cheap edition. Demy 8vo. Pp. 253+32 plates. (London and Glasgow: Wm. Collins, Sons and Co., Ltd., 1939.) 3*s.* 6*d.* net.

Schulz, Carl. Beiträge zur Anatomie und Biologie der Polytrichaceen. Roy. 8vo. Pp. 66. (Hamburg: Hansischer Gilden-Verlag, 1939.) 3.80 gold marks.

Sewell, Lt.-Col. R. B. S., Edited by. The Fauna of British India, including Ceylon and Burma. (Published under the patronage of the Secretary of State for India.) Butterflies, Vol. 1. By G. Talbot. Med. 8vo. Pp. xxix+600+3 plates. 35*s.* Mammalia, Vol. 1: Primates and Carnivora (in part), Families Felidæ and Viverridæ. By

R. I. Pocock. Med. 8vo. Pp. xxxiii +464 +31 plates. 30*s.* (London: Taylor and Francis, 1939.)*

Smyth, A. M. A Book of Fabulous Beasts. Cr. 8vo. Pp. 80. (London: Oxford University Press, 1939.) 1*s.* 6*d.* net.

Stolpe, M., und Zimmer, K. Der Vogelflug. Roy. 8vo. Pp. 159. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 11 gold marks.

Tansley, A. G. The British Islands and their Vegetation. Sup. Roy. 8vo. Pp. xxxviii +930 +162 plates. (Cambridge: At the University Press, 1939.) 45*s.* net.*

Williams, David, and Campbell, W. Easy Lessons in Nature Study. Book 3. Imp. 16mo. Pp. 96. (London: Oxford University Press, 1939.) 1*s.* 8*d.*

Wilson, Mrs. Douglas. Summer Holidays with Nature. Ex. Cr. 8vo. Pp. iv +316. (London: Macmillan and Co., Ltd., 1939.) 3*s.* 6*d.* net.

Anthropology: Archæology

Abbott, N. The Rise of the North Arabic Script and its Kurānic Development: with a full Description of the Kurān Manuscripts in the Oriental Institute. (University of Chicago Oriental Institute Publications, Vol. 50.) 4to. Pp. xxii +104 +33 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1939.) 50*s.* net.

Armitage, Harold. Early Man in Hallamshire. Med. 8vo. Pp. x +307. (London: Sampson Low, Marston and Co., Ltd., 1939.) 21*s.* net.

Asmus, G. Die Zulu. 8vo. Pp. 285 +16 plates. (Essen: Essener Verlags-Anstalt, 1939.) 5 gold marks.

Banks, Mrs. M. Macleod. British Calendar Customs. Scotland, Vol. 2: The Seasons, the Quarters, Hogmanay, January to May. (Published for the Folk-Lore Society.) Demy 8vo. Pp. xii +253 +8 plates. (London: William Glaisher, Ltd.; Glasgow: John Wylie and Co., 1939.) 15*s.**

Coon, Carleton Stevens. The Races of Europe. Roy. 8vo. Pp. xvi +739 +46 plates. (New York: The Macmillan Company, 1939.) 31*s.* 6*d.* net.*

East, Rupert, Translated and annotated by. Akiga's Story: the Tiv Tribe as seen by one of its Members. (Published for the International Institute of African Languages and Cultures.) Demy 8vo. Pp. xv +436 +24 plates. (London: Oxford University Press, 1939.) 21*s.* net.*

Engel, C., Herausgegeben von. Ostbaltische Frühzeit. (Baltische Lande, Band 1.) Sup. Roy. 8vo. Pp. 498. (Leipzig: S. Hirzel, 1939.) 40 gold marks.

Frazer, Sir James George. The Native Races of Asia and Europe: a Copious Selection of Passages for the Study of Social Anthropology from the Manuscript Notebooks of Sir James George Frazer. Arranged and edited from the MSS. by Robert Angus Downie. (Anthologia Anthropologica.) Demy. 4to. Pp. vii + 400. (London: Percy Lund, Humphries and Co., Ltd., 1939.) 35*s.* net.*

Glanville, S. R. K. Catalogue of Demotic Papyri in the British Museum. Vol. 1: A Theban Archive of the Reign of Ptolemy I, Soter. Roy. 4to. Pp. lii +73 +13 plates. (London: British Museum, 1939.) Paper, 33*s.*; cloth, 35*s.**

Jacobsen, T. The Sumerian King List. (Oriental Institute of the University of Chicago: Assyriological Studies, No. 11.) Roy. 8vo. Pp. xvi +218. (Chicago: University of Chicago Press; London: Cambridge University Press, 1939.) 25*s.* net.

Kossinna, G. Altgermanische Kulturhöhe. Siebente durchgesehene Auflage. 8vo. Pp. 82 +12 plates. (Leipzig: Curt Kabitzsch, 1939.) 1.80 gold marks.

Lindsay, Jack. A Short History of Culture. Demy 8vo. Pp. 408. (London: Victor Gollancz, Ltd., 1939.) 15*s.* net.

Mann, Ludovic MacLellan. The Druid Temple Explained: Being a set of Talks on Folklore, Myths and Prehistoric Religion. Fourth edition, enlarged. Demy 8vo. Pp. 16 +6 plates. (London: The Author, 18 Walbrook, E.C.4, 1939.) 1*s.**

Morey, C. R. The Mosaics of Antioch. 4to. Pp. 48 + 24 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 31*s.* 6*d.* net.

Oppenheim, M. Frhr von. Die Beduinen. Unter Mitarbeit von E. Bräunlich und W. Caskel. 5 Bände. Sup. Roy. 8vo. Band 1: Die Beduinenstämme in Mesopotamien und Syrien. Pp. 387 +xx. (Leipzig: Otto Harrassowitz, 1939.) 24 gold marks.

Radcliffe-Brown, A. R. Taboo. (The Frazer Lecture, 1939.) Cr. 8vo. Pp. 48. (Cambridge: At the University Press, 1939.) 2*s.* 6*d.* net.*

Sandford, K. S., and Arkell, W. J. Paleolithic Man and the Nile Valley in Lower Egypt, with some Notes upon a Part of the Red Sea Littoral: a Study of the Regions during Pliocene and Pleistocene Times. (University of Chicago Oriental Institute Publications, Vol. 46: Prehistoric Survey of Egypt and Western Asia, Vol. 4.) 4to. Pp. xx +108 +30 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1939.) 40*s.* net.

Schulz, Walther. Vorgeschichte. (Stoffe und Gestalten der deutschen Geschichte, Band 1, Heft 1.) Med. 8vo. Pp. 23. (Leipzig und Berlin: B. G. Teubner, 1938.) 0.80 gold mark.

Shipton, G. M. Notes on the Megiddo Pottery of Strata VI–XX. (Oriental Institute of the University of Chicago: Studies in Ancient Oriental Civilization, No. 17.) Roy. 8vo. Pp. xiv +52 +20 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1939.) 20*s.* net.

Philosophy: Psychology

Anderson, Paul Russell, and Fisch, Max Harold. Philosophy in America: from the Puritans to James, with Representative Selections. (Century Philosophy Series.) Med. 8vo. Pp. xiii +570. (New York and London: D. Appleton-Century Co., Inc., 1939.) 18*s.* net.*

Bartlett, F. C., Ginsberg, M., Lindgren, E. J., and Thouless, R. H., Edited by. The Study of Society: Methods and Problems. Sup. Roy. 16mo. Pp. xii +498. (London: Kegan Paul and Co., Ltd., 1939.) 10*s.* 6*d.* net.*

Belin, Jean. La logique d'une idée-force: l'idée d'utilité sociale et la révolution française (1789–1792). Roy. 8vo. Pp. 636. (Paris: Hermann et Cie., 1939.) 120 francs.*

Belin, Jean. Les démarches de la pensée sociale: d'après des textes inédits de la période révolutionnaire (1789–1792). Roy. 8vo. Pp. 43. (Paris: Hermann et Cie., 1939.) 20 francs.*

Brown, William. Mind, Medicine and Metaphysics: the Philosophy of a Physician. Cr. 8vo. Pp. 294. (London: Oxford University Press, 1939.) 5*s.* net.

Burgess, Joseph B. Introduction to the History of Philosophy. Med. 8vo. Pp. xi +631. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 18*s.**

Cornford, Francis Macdonald. Plato and Parmenides: Parmenides' "Way of Truth" and Plato's "Parmenides". Translated with an Introduction and a Running Commentary. (International Library of Psychology, Philosophy and Scientific Method.) Demy 8vo. Pp. xvii +251. (London: Kegan Paul and Co., Ltd., 1939.) 12*s.* 6*d.* net.*

Dewey, John. Theory of Valuation. (International Encyclopedia of Unified Science. Vol. 2: Foundations of the Unity of Science, No. 4.) Sup. Roy. 8vo. Pp. vii +67. (Chicago: University of Chicago Press; London: Cambridge University Press, 1939.) 5*s.* net.*

Ducassé, Pierre. Méthode et intuition chez Auguste Comte. (Bibliothèque de philosophie contemporaine.) Med. 8vo. Pp. x +620. (Paris: Félix Alcan, 1939.) 80 francs.*

Ducassé, Pierre. Essai sur les origines intuitives du positivisme. (Bibliothèque de philosophie contemporaine.) Med. 8vo. Pp. x +272 +4 plates. (Paris: Félix Alcan, 1939.) 50 francs.*

Dumas, Georges. Les fonctions systématisées de la vie affective et de la vie active. (Nouveau traité de psychologie, Tome 6.) Roy. 8vo. Pp. 546 +iv. (Paris: Félix Alcan, 1939.) 125 francs.*

Isenberg, C. D. Dass wir Menschen würden . . . Erkenntnis und Tat. Med. 8vo. Pp. 285. (Weimar: Lautenbach Verlag, 1938.) 5.80 gold marks.

Jacoby, H. J. Analysis of Handwriting: an Introduction into Scientific Graphology. Demy 8vo. Pp. 286 + 27 plates. (London: George Allen and Unwin, Ltd., 1939.) 10*s.* 6*d.* net.*

Kanga, D. D., Edited by. Where Theosophy and Science Meet: a Stimulus to Modern Thought. Part 3: God—from Humanity to Divinity. Demy 8vo. Pp. xix + 260. (Adyar: Adyar Library Association, 1939.) 2.4 rupees.*

MacColl, Sylvia H. A Comparative Study of the Systems of Lewin and Koffka with Special Reference to Memory Phenomena. (Contributions to Psychological Theory, Vol. 2, No. 1, Serial No. 5.) 8vo. Pp. viii + 160. (Durham, N.C.: Duke University Press; London: Cambridge University Press, 1939.) 7*s.* 6*d.* net.

Mégroz, R. L. The Dream World. Ex. Cr. 8vo. Pp. 319. (London: John Lane, The Bodley Head, Ltd., 1939.) 10*s.* 6*d.* net.

Nicholson, J. A. An Introductory Course in Philosophy. Demy 8vo. Pp. xii + 508. (New York: The Macmillan Company, 1939.) 12*s.* net.*

Preiswerk, A. Das Einzelne bei Platon und Aristoteles. (Philologus, Supplement-Band 22, Heft 1.) Roy 8vo. Pp. 196. (Leipzig: Dieterich'sche Verlagsbuchhandlung, 1939.) 11 gold marks.

Urban, Wilbur Marshall. Language and Reality: the Philosophy of Language and the Principles of Symbolisms. (Library of Philosophy.) Demy 8vo. Pp. 756. (London: George Allen and Unwin, Ltd., 1939.) 21*s.* net.*

Bacteriology: Hygiene

Bergey's Manual of Determinative Bacteriology: a Key for the Identification of Organisms of the Class Schizomycetes. By David H. Bergey, Robert S. Breed, E. G. D. Murray and H. Parker Hitchens. Fifth edition. Med. 8vo. Pp. xi + 1032. (London: Baillière, Tindall and Cox, 1939.) 45*s.**

Bigger, Joseph W. Handbook of Bacteriology: for Students and Practitioners of Medicine. Fifth edition. Demy 8vo. Pp. xvi + 466. (London: Baillière, Tindall and Cox, 1939.) 12*s.* 6*d.*

Chalmers, C. H. Bacteria in relation to the Milk Supply: a Practical Guide for the Commercial Bacteriologist. Second edition. Cr. 8vo. Pp. xii + 209. (London: Edward Arnold and Co., 1939.) 6*s.* net.*

Da Rocha-Lima, H., Reis, J., und **Silberschmidt, K.** Methoden der Virusforschung. Roy. 8vo. Pp. 384. (Berlin und Wien: Urban und Schwarzenberg, 1939.) 22 gold marks.

Gildemeister, E., Haagen, E., Waldmann, O., Herausgegeben von. Handbuch der Viruskrankheiten: mit besonderer Berücksichtigung ihrer experimentellen Erforschung. Band 1. Sup. Roy. 8vo. Pp. 652. (Jena: Gustav Fischer, 1939.) 40 gold marks.

Henrici, Arthur T. The Biology of Bacteria: an Introduction to General Microbiology. Second edition. Med. 8vo. Pp. xiv + 494. (Boston, New York and Chicago: D. C. Heath and Co.; London: George G. Harrap and Co., Ltd., 1939.) 15*s.* net.*

Jordan, H. Tropical Hygiene and Sanitation. 18mo. Pp. 388. (London: Baillière, Tindall and Cox, 1939.) 5*s.*

Lloyd, Wyndham E. B. A Hundred Years of Medicine. (Duckworth's 100 Years Series.) Demy 8vo. Pp. 344. (London: The Scientific Book Club, 1939.) 2*s.* 6*d.**

McCoy, Elizabeth, and **McClung, L. S.** The Anaerobic Bacteria and their Activities in Nature and Disease: a Subject Bibliography. In 2 vols. Demy 4to. Vol. 1: Chronological Author Index. Pp. xxiii + 295. Vol. 2: Subject Index. Pp. xi + 602. (Berkeley, Calif.: University of California Press; London: Cambridge University Press, 1939.) 50*s.* net.*

Mellanby, Sir Edward. Recent Advances in Medical Science: a Study of their Social and Economic Implications. (The Bede Lecture delivered before the University of Cambridge on 28 April 1939.) Cr. 8vo. Pp. 62. (Cambridge: At the University Press, 1939.) 2*s.* 6*d.* net.*

Newman, Sir George. The Building of a Nation's Health. Demy 8vo. Pp. xiv + 479 + 8 plates. (London: Macmillan and Co., Ltd., 1939.) 21*s.* net.*

Nicol, Hugh. Microbes by the Million. (Pelican Special, S28.) Cr. 8vo. Pp. 248 + 8 plates. (Harmondsworth, Middx.: Penguin Books, Ltd., 1939.) 6*d.**

Pickles, William Norman. Epidemiology in Country Practice. Demy 8vo. Pp. viii + 110. (Bristol: John Wright and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1939.) 7*s.* 6*d.* net.*

Scott, H. Harold. A History of Tropical Medicine: based on the Fitzpatrick Lectures delivered before the Royal College of Physicians of London, 1937–38. Med. 8vo. Vol. 1. Pp. xix + 648 + 3 plates. Vol. 2. Pp. iv + 649–1165 plates 4–13. (London: Edward Arnold and Co., 1939.) 50*s.* net.*

Miscellany

Catlin, George. The Anglo-Saxon Tradition. Demy 8vo. Pp. xii + 286. (London: Kegan Paul and Co., Ltd., 1939.) 10*s.* 6*d.* net.*

Collingwood, R. G. An Autobiography. Demy 8vo. Pp. v + 168. (London: Oxford University Press, 1939.) 7*s.* 6*d.* net.*

Cornish, James George. Reminiscences of Country Life Edited by Vaughan Cornish. Demy 8vo. Pp. xi + 147 + 8 plates. (London: *Country Life*, Ltd., 1939.) 10*s.* 6*d.* net.*

Dolobran, Lord Lloyd of. Leadership in Democracy. (Walker Trust Lectures on Leadership, No. 7, delivered before the University of St. Andrews, 14 November 1938.) Demy 8vo. Pp. 22. (London: Oxford University Press, 1939.) 2*s.* net.*

Haslett, A. W. Unsolved Problems of Science. Ex. Cr. 8vo. Pp. xi + 318. (London: The Scientific Book Club, 1939.) 2*s.* 6*d.**

Hausrath, Jr., Alfred H., and **Harms, John H.** Consumer Science: a Fusion Course in Physical Science applied to Consumer Problems. Med. 8vo. Pp. xii + 692. (New York: The Macmillan Company, 1939.) 10*s.* 6*d.* net.

Hilgenberg, Luise, und **Kirfel, Willibald.** Vāgbhaṭa's Aṣṭaṅgahṛdayasaṃhitā: ein altindisches Lehrbuch der Heilkunde. Aus dem Sanskrit ins deutsche übertragen, mit Einleitung, Anmerkungen und Indices. Roy. 8vo. Lieferung 8. Pp. 449–512. (Leiden: E. J. Brill, Ltd., 1939.) 3.50 guilders.*

Joseph, H. W. B. Harold Henry Joachim, 1868–1938. (From the *Proceedings of the British Academy*, Vol. 24.) Roy. 8vo. Pp. 30. (London: Oxford University Press, 1939.) 2*s.* 6*d.* net.*

Lovell, Bernard. Science and Civilization. (Discussion Books, No. 63.) Cr. 8vo. Pp. 150. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1939.) 2*s.* net.*

Morgan, A. E. The Needs of Youth: a Report made to King George's Jubilee Trust Fund. Demy 8vo. Pp. xi + 434 + 8 plates. (London: Oxford University Press, 1939.) 10*s.* net.*

Parkins, A. E., and **Whitaker, J. R.,** Editors. Our Natural Resources and their Conservation. Second edition. Med. 8vo. Pp. xiv + 647. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 25*s.* net.*

Spence-Sales, H., and **Bland, John.** England's Water Problems: a Survey of Rainfall, Drought and Distribution. Demy 8vo. Pp. xii + 275. (London: *Country Life*, Ltd., 1939.) 18*s.* net.

Taylor, F. Sherwood. General Science for Schools. Part 3. Demy 8vo. Pp. xi + 271 + plates 17–24. (London: William Heinemann, Ltd., 1939.) 3*s.**

Walton, Robert P. Marihuana, America's New Drug Problem: a Sociologic Question with its Basic Explanation dependent on Biologic and Medical Principles. Med. 8vo. Pp. ix + 223 + 12 plates. (Philadelphia and London: J. B. Lippincott Co., 1938.) 12*s.* 6*d.* net.*

Wells, H. G. The Fate of Homo Sapiens: an Unemotional State of the Things that are Happening to him Now, and of the Immediate Possibilities Confronting Him. Ex. Cr. 8vo. Pp. vi + 330. (London: Martin Secker and Warburg, Ltd., 1939.) 7*s.* 6*d.* net.*